ENGINEERED MOTOR REPAIRING

RERINGING

RECONDITIONING

REBUILDING

McQUAY-NORRIS MFG. CO.

ST. LOUIS 10, U. S. A.

PISTON RING END CLEARANCE

Diameter of Cylinder	Min. End Clearance Before Plating	Max. End Clearance Before Plating
0 - 1-31/32	.005	.013
2 - 2-31/32	.007	.017
3 - 3-31/32	.010	.020
4 - 4-31/32	.013	.025
5 - 6-31/32	.017	.032
7 - 8-31/32	.023	.040
9 - 12	(.003 per dia. inch plus .015)	

These are minimum end clearances based on approx. .0035 per inch of cylinder diameter. Never install rings with less clearance than shown on the above chart.

Slightly larger clearances are satisfactory.

Where any fitting is necessary, use any one of the several tools designed for the purpose. If no tool is available, clamp the ring in a vise, so the end of the ring is just above the vise top. Then with a file take many light cuts, being careful not to twist the ring or distort it in any manner.

Always fit the ring to the smallest cylinder diameter (usually just below the lower end of the ring travel).

PISTON RING SIDE CLEARANCE

Aluminum Pistons

.0015″-.002 ″ Top groove
.001 ″-.0015″ Lower grooves

Gray Iron Pistons

.002 ″-.0025″ Top groove
.0015″-.002 ″ Lower grooves

Measure the side clearance with a feeler gauge. If fitting is necessary, rub the ring lightly on a piece of fine emery cloth placed on a surface plate or other flat surface until the proper feeler gauge can be inserted between the side of the ring and the side of the ring groove.

Always clean piston groove before fitting rings.

BEARING CLEARANCE

The average safe clearance between crankshaft and bearing should not exceed two to two and one-half thousandths (.002 to .0025) of an inch. This can be measured by using a feeler gauge or a thin piece of soft lead wire.

See specific instructions for the engine being worked on.

VALVE STEM CLEARANCE

Intake.................................. .002″-.003″
Exhaust................................ .003″-.004″

These are average safe clearances.

PISTON CLEARANCE

CAM "A"—Chevrolet Six cast iron pistons must be cam ground with cam "A." Any cast iron piston in the automotive range can be cam ground with cam "A" at the option of the user. Use the following clearances when finishing either round or with cam "A":

Cyl. Diam.	2½	2¾	3	3¼	3½	3¾
All Lands	.010	.011	.012	.013	.014	.015
Skirt	.002½	.002¾	.003	.003¼	.003½	.004
Cyl. Diam.	4	4¼	4½	4¾	5	
All Lands	.016	.017	.018	.019	.021	
Skirt	.004½	.004¾	.005¼	.005¾	.006¼	

CAM "B"—Ford "A" and "V8" pistons, and all pistons of the all-aluminum type having a split skirt completely open from top to bottom. Any Nelson wide strut or narrow strut Bohnalite piston can be cam ground with cam "B" at the option of the user. Use the following clearances when grinding round. Skirt clearance should be cut in half when using cam "B":

Cyl. Diam.	2½	2¾	3	3¼	3½	3¾
All Lands	.018	.019	.020	.021	.023	.025
Skirt	.001¾	.002	.002¼	.002½	.002¾	.003¼
Cyl. Diam.	4	4¼	4½	4¾	5	
All Lands	.027	.030	.033	.036	.039	
Skirt	.003½	.003¾	.004	.004¼	.004½	

CAM "C"—Must be used on all T-slot or U-slot flexible skirt all-aluminum pistons, having a solid section at bottom of skirt, from 2¾ to 3 7/16″ diameter.

CAM "D"—Must be used on all T-slot or U-slot flexible skirt all-aluminum pistons, having a solid section at bottom of skirt, from 3½ to 4 15/16″ diameter.

Use the following clearances with both cam "C" and cam "D":

Cyl. Diam.	2¾	3	3¼	3½	3¾
All Lands	.019	.020	.021	.023	.025
Skirt	.001¼	.001½	.001¾	.002	.002¼
Cyl. Diam.	4	4¼	4½	4¾	
All Lands	.027	.030	.033	.036	
Skirt	.002½	.002¾	.003	.003¼	

CAM "E"—Must be used on Nelson Autothermic pistons. Same shape as Cam "B" but with .013″ drop at pin, which is necessary because of the solid skirt. On Autothermic pistons with complete vertical skirt slot (for Packard), use Cam "B."

SEE INSTALLING INSTRUCTIONS FURNISHED WITH EACH SET OF PISTONS FOR SPECIFIC CLEARANCES OF THE TYPE OF PISTON BEING INSTALLED

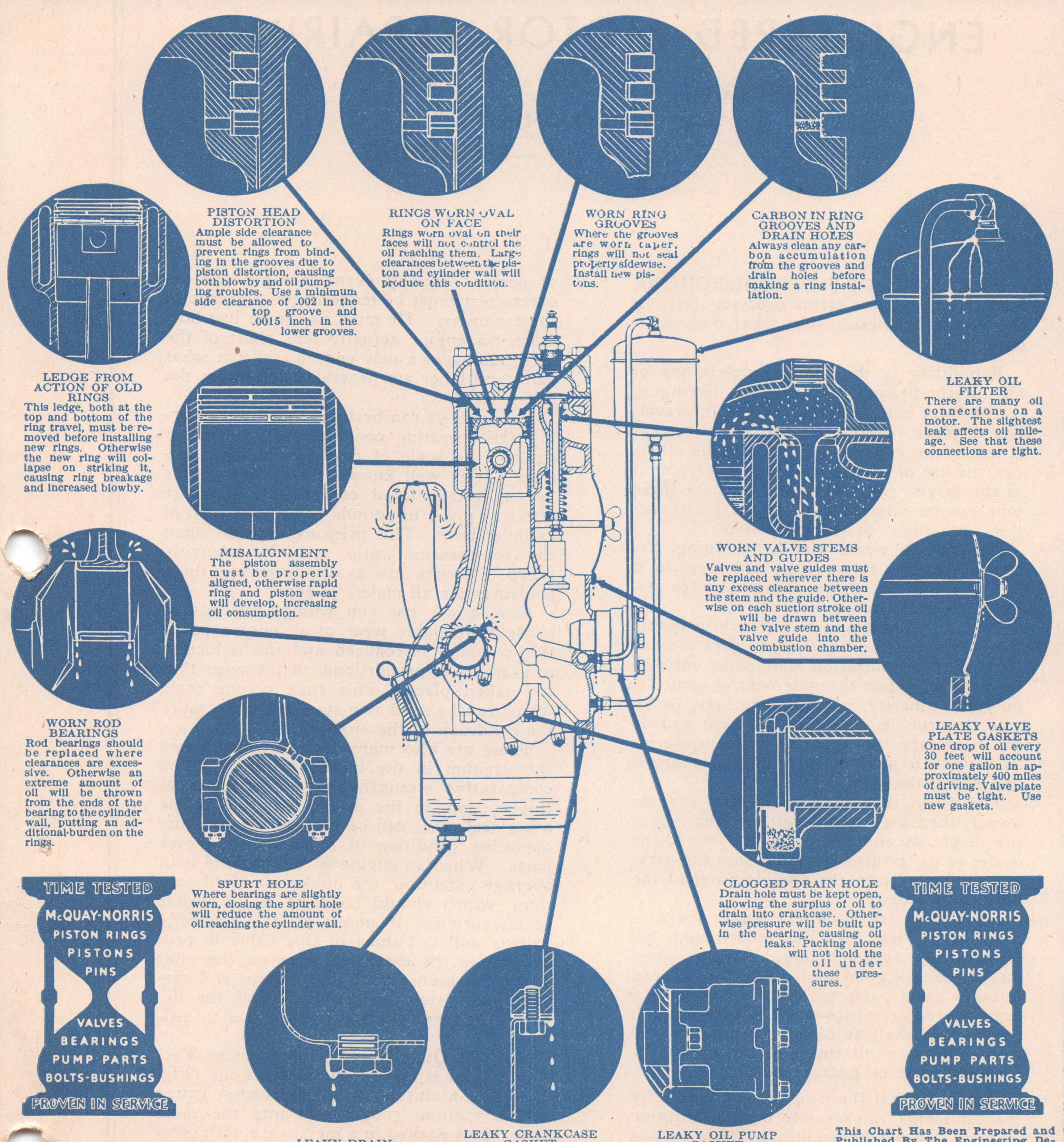
PISTON PIN CLEARANCE

Pin fits naturally depend upon the condition of the pin hole. The more accurately a pin hole is finished the looser the pin will feel with the same clearance. The fits specified below cover an average condition.

	Oscillating	Full Floating	Set Screw
Cast Iron—Bushed	Thumb Fit		
Cast Iron—Not Bushed	Free Drop	Light Drive Fit	Light Drive Fit
High Silicon	Thumb Fit	Thumb Fit	Light Drive Fit
Other Aluminum	Palm Fit	Light Drive Fit	Light Drive Fit

PRINTED IN U.S.A. Form No. 3780

A CHART OF MOTOR ILLS



PISTON HEAD DISTORTION
Ample side clearance must be allowed to prevent rings from binding in the grooves due to piston distortion, causing both blowby and oil pumping troubles. Use a minimum side clearance of .002 in the top groove and .0015 inch in the lower grooves.

RINGS WORN OVAL ON FACE
Rings worn oval on their faces will not control the oil reaching them. Large clearances between the piston and cylinder wall will produce this condition.

WORN RING GROOVES
Where the grooves are worn taper, rings will not seal properly sidewise. Install new pistons.

CARBON IN RING GROOVES AND DRAIN HOLES
Always clean any carbon accumulation from the grooves and drain holes before making a ring installation.

LEDGE FROM ACTION OF OLD RINGS
This ledge, both at the top and bottom of the ring travel, must be removed before installing new rings. Otherwise the new ring will collapse on striking it, causing ring breakage and increased blowby.

LEAKY OIL FILTER
There are many oil connections on a motor. The slightest leak affects oil mileage. See that these connections are tight.

MISALIGNMENT
The piston assembly must be properly aligned, otherwise rapid ring and piston wear will develop, increasing oil consumption.

WORN VALVE STEMS AND GUIDES
Valves and valve guides must be replaced wherever there is any excess clearance between the stem and the guide. Otherwise on each suction stroke oil will be drawn between the valve stem and the valve guide into the combustion chamber.

WORN ROD BEARINGS
Rod bearings should be replaced where clearances are excessive. Otherwise an extreme amount of oil will be thrown from the ends of the bearing to the cylinder wall, putting an additional burden on the rings.

LEAKY VALVE PLATE GASKETS
One drop of oil every 30 feet will account for one gallon in approximately 400 miles of driving. Valve plate must be tight. Use new gaskets.

SPURT HOLE
Where bearings are slightly worn, closing the spurt hole will reduce the amount of oil reaching the cylinder wall.

CLOGGED DRAIN HOLE
Drain hole must be kept open, allowing the surplus of oil to drain into crankcase. Otherwise pressure will be built up in the bearing, causing oil leaks. Packing alone will not hold the oil under these pressures.

LEAKY DRAIN

LEAKY CRANKCASE GASKET

LEAKY OIL PUMP GASKET

Any concrete road is evidence of the tremendous amount of oil lost through leaks from the underpart of a motor. All bolts should be drawn uniformly tight. Always use new gaskets.

TIME TESTED
McQUAY-NORRIS
PISTON RINGS
PISTONS
PINS
VALVES
BEARINGS
PUMP PARTS
BOLTS-BUSHINGS
PROVEN IN SERVICE

This Chart Has Been Prepared and Published By The Engineering Department of The McQuay-Norris Mfg. Co., St. Louis, U. S. A.

ENGINEERED MOTOR REPAIRING

—RERINGING
—RECONDITIONING
—REBUILDING

RERINGING, RECONDITIONING, REBUILDING are terms used regularly in the repair business. Just what does each one mean?

Rebuilding is the most complete job of all. Reconditioning is next, and Reringing is the least complete. Each one, however, has its place. And when the age of the car is taken into consideration, the value of the car, the use of the car and the temperament of the driver, the proper one of these three jobs can be selected and complete satisfaction guaranteed to the car owner.

Get the job, whether it is Reringing, Reconditioning or Rebuilding, and then do it right. Do it so that you can guarantee satisfactory performance.

It is not a one-man job. It concerns many. The car owner as a rule considers his car from the transportation standpoint only, so he must rely upon the judgment of some reputable authority, a motor engineer, to locate the trouble, measure its extent and do the necessary work. The motor engineer needs tools to aid him in making his analysis and doing the work.

The chain then consists of first the car owner, then the motor engineer who makes the diagnosis and who does the work, the dealer or distributor who furnishes the parts and tools, and last, the manufacturer of the parts and tools.

Since they are all interested in the outcome of the job, each one must accept his share of the responsibility. It takes good mechanics and good tools to do the job and it takes good parts to stand up under the exacting requirements—so it is only through the correct analysis of the trouble and the co-operation of all that satisfaction to the car owner can be guaranteed.

It may be that the trouble experienced by the car owner is excessive oil consumption or excessive gas consumption, noise or loss of power. In any event, a rapid and accurate test must be made in the presence of the car owner. He must be shown just how much his engine actually falls short of the performance of a new engine and just what parts and labor are necessary to restore the difference.

The analysis can best be made by measuring the operating conditions of the motor against the scale of compression and vacuum. It is well known that every engine has a certain rated compression pressure which is given in pounds per square inch of cylinder bore. This pressure depends upon the compression ratio and the cranking speed. Charts are available giving these pressures for all makes of cars.

After a car has run enough mileage to cause appreciable wear of all engine parts, this pressure is reduced and the reduction in pressure is proportional to the wear that has taken place. This then is one scale which can be used as a standard to measure the condition of the engine.

There are also many factors which affect the vacuum in the intake manifold. The comparative strength and unsteadiness of this vacuum in the intake manifold is the other scale that can be used to measure the operating condition of many vital motor parts. When an engine is running and is in average condition, the intake manifold vacuum, which should be close to 18 inches of mercury (or 18 points as it is generally called) will fall short of this value in proportion to the extent of wear on the vital parts, the accuracy of the ignition and carburetion system adjustments, and the decrease in atmospheric pressure due to altitude.

The McQuay-Norris Compression-Vacuum Tester is two instruments in one (Fig. 1). It contains both a compression gauge and a vacuum gauge built into the same case. It is packed in a metal case with com-

plete instructions for its use, together with charts showing the compression pressure at cranking speed of all makes of cars, the significance of different compression and vacuum readings, and printed forms for recording the data.

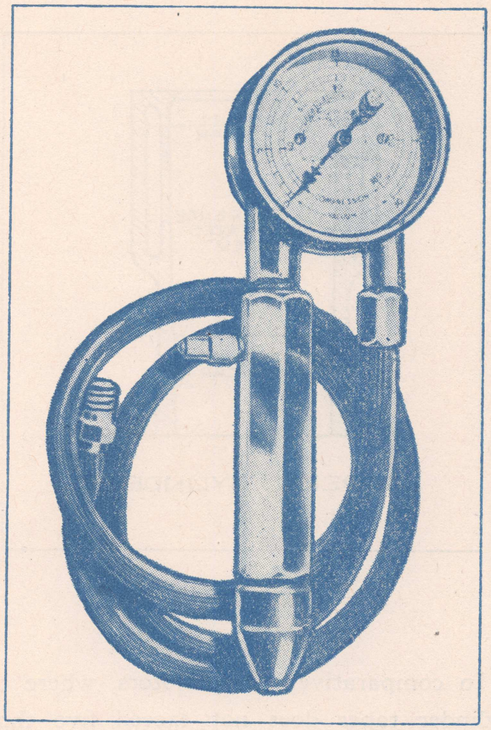


FIG 1

It is possible with this instrument to test cylinder compression and manifold vacuum. From the result of these tests the motor trouble can be ascertained, that is, whether the trouble is due to pistons, piston rings, valves, valve springs, valve guides or other related parts.

Bearings play a most important part in the control of oil consumption. The ring and piston assembly is designed to control just so much oil. Worn bearings allow a greater amount of oil to reach the pistons, rings and cylinder walls than is necessary, consequently throwing a greater burden on the rings. The McQuay-Norris Bearing Oil Leak Tester will show this extra amount of oil being lost from the ends of the bearings (Fig. 2).

Now after the owner of the car has watched you make this analysis and you have shown him what is wrong, then turn to the McQuay-Norris Motor Ills Chart (see page one) and show him the many points of

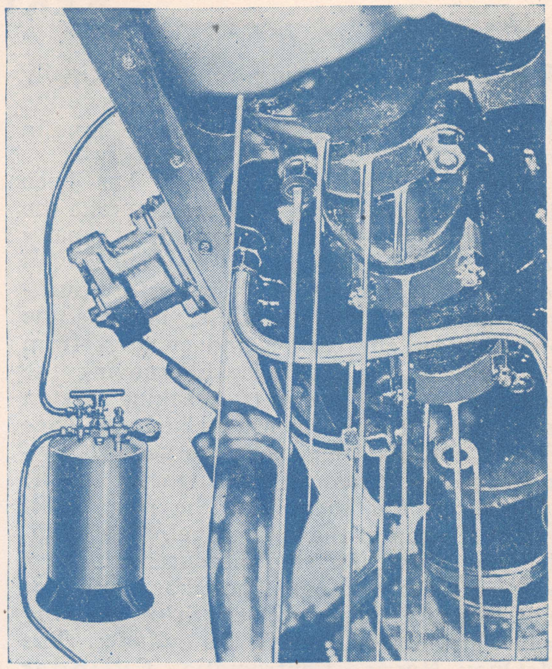


FIG. 2

oil loss that are so clearly illustrated and explained. He will readily be able to see the importance of the pistons, piston rings and piston pins, of the cylinders, bearings, valves, valve guides and valve springs, and of their relationship to the guaranteeing of satisfactory motor performance.

Reringing only may be required, or it may be necessary to Recondition, or it may be best to completely Rebuild the motor.

These three jobs differ considerably. The more complete the job is to be done, the greater will be the investment in replacement parts, labor, special tools and specialized mechanics. This in plain terms to the car owner means that he must be willing to pay in proportion to the extent of work done.

It would not be wise to rebuild a 10-year old engine of very little value when the car is being used for trips to the grocery store. Nor would it be wise merely to rering a late model when the owner is very particular about the performance and is using his car continually on extensive trips.

Consequently by taking into consideration the age and value of the car, the use of the car and the temperament of the driver, the most practical and economical decision can be made, and then by following the correct mechanical procedure in Reringing, Reconditioning or Rebuilding, you can guarantee satisfactory performance to the car owner.

RERINGING

WHILE Reringing refers principally to the installation of rings only, there are other things that must be done in order to insure satisfactory results.

The first step after the job has been decided upon is to drop the pan and take the head off. Experienced mechanics usually scrape the carbon off of the block and remove the top cylinder ledges before pushing out the piston assemblies because the pistons keep the carbon and cuttings from getting into the crankcase. Removing the ledge first also prevents breaking piston lands when the pistons are pushed out. (See Figs. 5 and 6.) Then with the use of a cylinder gauge measure the diameter of the cylinder at the bottom of the ring travel and at the top of the ring travel. The cylinder gauge used for this measurement must be very accurately constructed and one that will measure the entire length of the ring travel and center itself in the cylinder. The McQuay-Norris Centromatic Cylinder Gauge will make this measurement (Fig. 3).

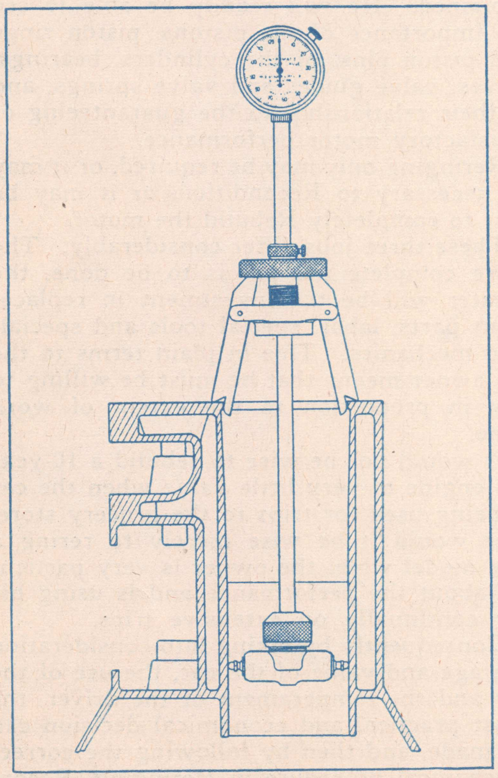


FIG. 3

The minimum cylinder diameter measured at the lower end of the ring travel will determine the proper ring size. The difference between this measurement and the measurement of the maximum diameter at the upper end of the ring travel will denote the taper and therefore the type of ring to use (Fig. 4).

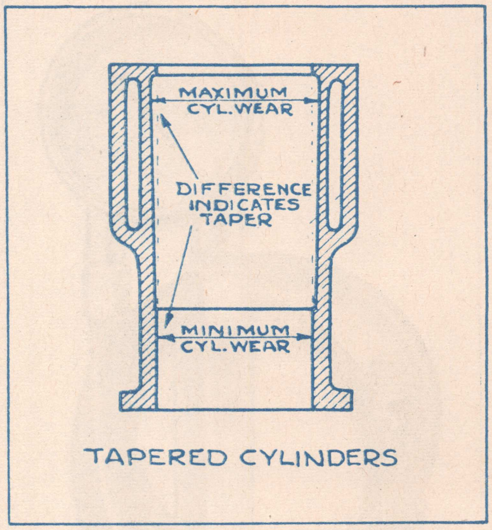


FIG. 4

In comparatively new motors, where the cylinder taper does not exceed five thousandths (.005) of an inch, install either Rebore-Rebuild Sets or Factory Type Sets, depending upon your preference for either expander type rings or non-expander type rings.

Where the taper is extreme, as is found among older jobs or motors that have been run under severe operating conditions, Leak-Proof Sets should be used.

There are motors where the wear is not so severe—borderline cases—where either Leak-Proof or Rebore-Rebuild Sets will give excellent results.

Not only is it important to get the right set of rings for the cylinder conditions, but the other causes of oil consumption must also be considered and the troublesome ones for any particular motor corrected.

While in a reringing job all corrections cannot be made, there are certain ones that must be made to insure the best results.

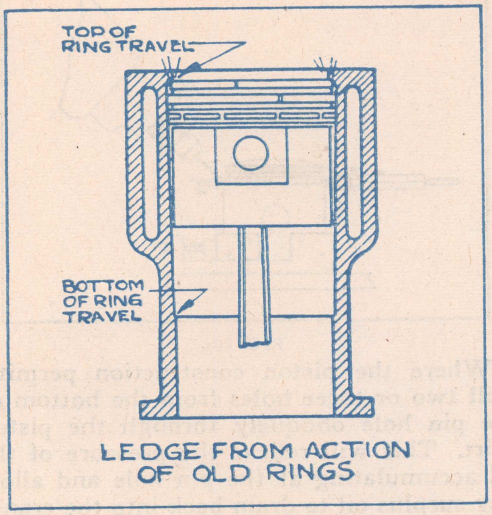


FIG. 5

A ridge or ledge found at the top of the ring travel and in some cases at the bottom of the ring travel (Fig. 5) must be removed. A ridge reamer is used to remove the top ridge (Fig. 6), and in this operation great care must be taken so that the tool does not undercut the cylinder wall below the ledge.

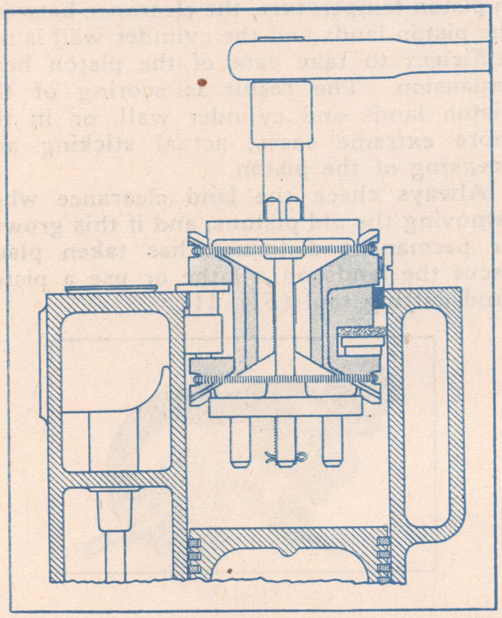


FIG. 6

This is so important that no tool should be used where this has not been considered in its design. The ridge at the bottom of the ring travel can be removed with a hone.

Rings are pinned in one position on the piston in certain jobs. The result is a vertical ridge on the cylinder wall. If this is not removed the new rings will be held away from the cylinder wall on each side of the ridge and blowby and oil consumption will result. This vertical ridge can be removed by honing (Fig. 6a).

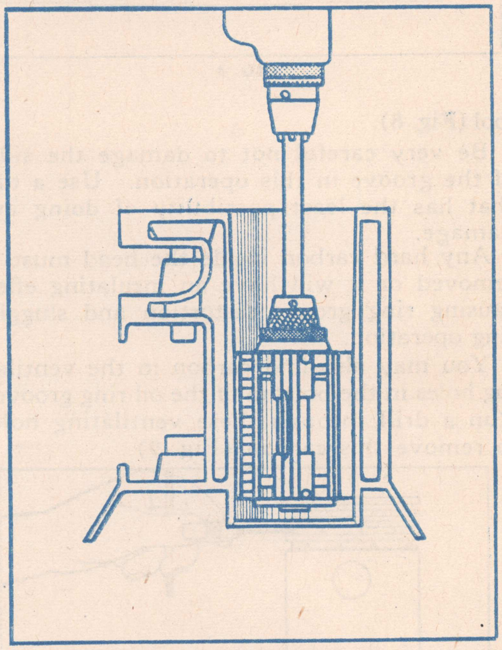


FIG. 6a

You must next examine the pistons with the idea of making any corrections that will be of help in operation It will be found that there is a carbon deposit in the bottom of the ring grooves (Fig. 7).

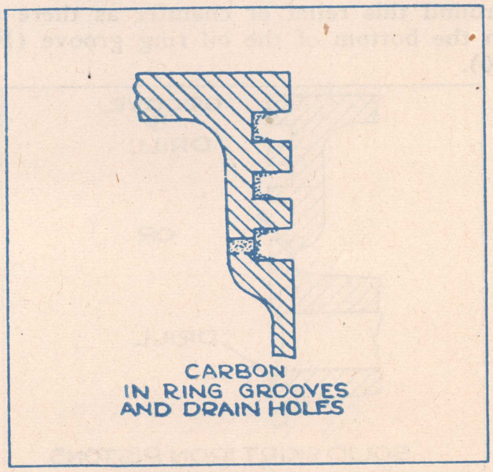


FIG. 7

Reringing—Continued

Remove the old rings and clean the grooves thoroughly with a groove cleaning

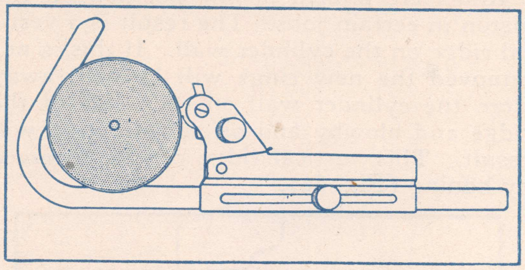


FIG. 8

tool (Fig. 8).

Be very careful not to damage the sides of the groove in this operation. Use a tool that has the least possibility of doing any damage.

Any hard carbon inside the head must be removed or it will have an insulating effect causing ring groove distortion and sluggish ring operation.

You may also find carbon in the ventilating holes in the bottom of the oil ring grooves. Run a drill through these ventilating holes to remove this carbon (Fig. 9).

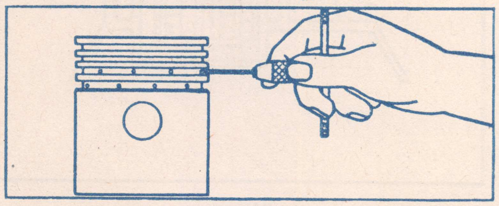


FIG. 9

The addition of a relief or chamfer cut in the lower corner of the oil ring groove located above the pin hole is of help in controlling the surplus oil. Drill obliquely through the piston skirt, half as many holes around this relief or chamfer as there are in the bottom of the oil ring groove (Fig. 10).

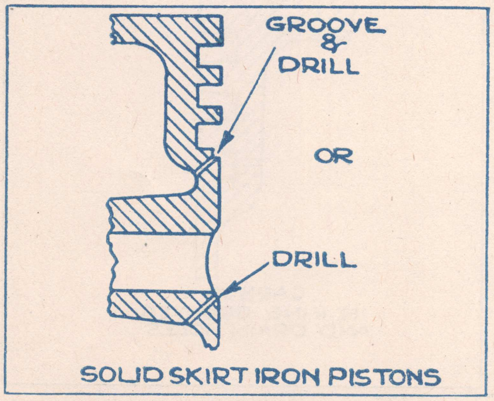


FIG. 10

A chamfering tool with a drill guide is very handy for this operation. (See Fig. 10a.)

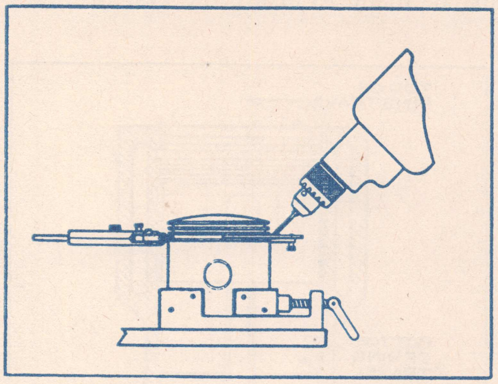


FIG. 10a

Where the piston construction permits, drill two or three holes from the bottom of the pin hole obliquely through the piston skirt. This will relieve the pressure of the oil accumulating at the pin hole and allow any surplus oil to drain back into the crankcase.

It is characteristic of metal to grow under certain operating conditions, and this becomes most serious in pistons where the lands have increased in diameter. Trouble from this land growth doesn't generally take place with the old set of rings, but with the installation of new rings and the increase in piston temperature, the clearance between the piston lands and the cylinder wall is not sufficient to take care of the piston head expansion. The result is scoring of the piston lands and cylinder wall, or in the more extreme cases, actual sticking and breaking of the piston.

Always check the land clearance when removing the old pistons, and if this growth or permanent distortion has taken place, recut the lands on a lathe or use a piston land cutting tool (Fig. 11).

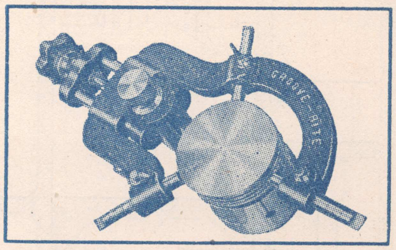


FIG. 11

The pistons may have collapsed to some extent through abuse, or with the cylinder wall wear and the piston wear the clearance between the piston skirt and the cylinder

may be excessive. Resizing the piston with a Piston Resizer will increase the diameter of the piston skirt by several thousandths (Fig. 12). Before reringing examine pistons for cracks. Do not attempt to resize cracked pistons. They must be replaced.

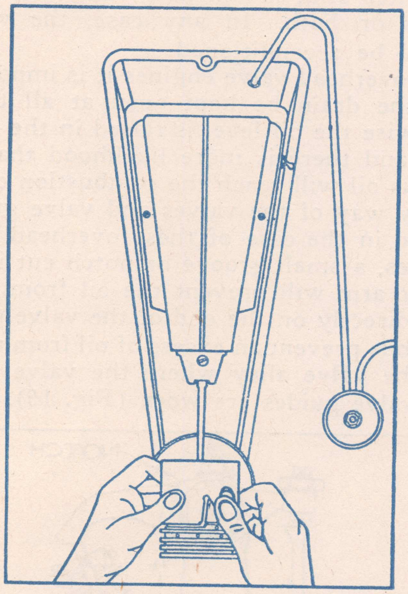


FIG. 12

Instead of resizing the pistons it may be more desirable to install McQuay-Norris cushion lock expanders (Fig. 13) or the new McQuay-Norris shell type expanders (Fig. 13A).

The cushion lock expander is installed without the use of any special tools. No drilling or grooving is necessary. Just push the expander into place until it locks above the piston bosses.

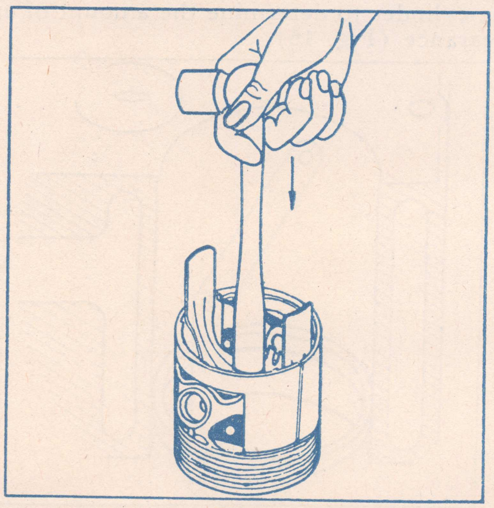


FIG. 13

Installation of the new shell type piston expanders does not require removal of the connecting rod from the piston or even the piston assembly from the engine. Most piston expanders of this type can be tapped into place using a small ball peen hammer (Fig. 13A). The Chevrolet slipper type iron pistons are so constructed that a special pliers is used to get the shell type expander into place.

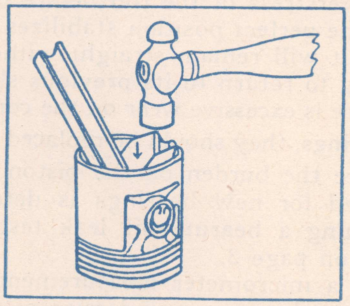


FIG. 13a

It is important to replace worn pins and rod bushings, especially if oil under pressure reaches the pins due to the rods being rifle drilled.

The piston and connecting rod assembly must now be checked for alignment and any corrections made that are necessary (Fig. 13b).

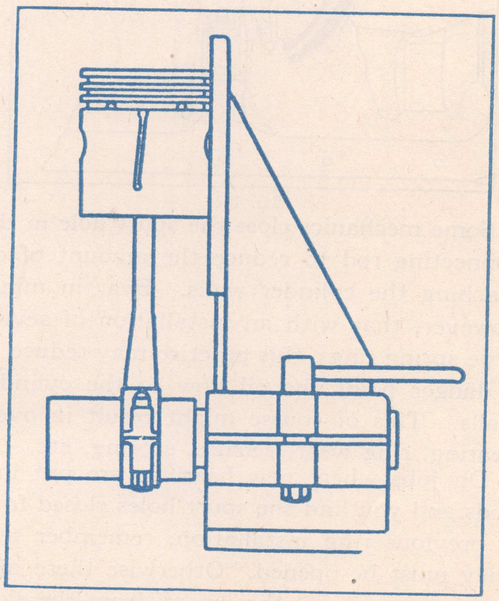


FIG. 13b

It isn't sufficient merely to check the connecting rod by itself for alignment. The piston should be installed on the connecting rod and the entire assembly checked, first, for alignment taken between the piston skirt

Reringing—Continued

and the crank-pin bearing hole of the connecting rod; second, for twist in the connecting rod; and third, for offset of the connecting rod.

Where the assembly is not correctly aligned and it is necessary to straighten the rods, the best practice is to bend them slightly beyond the correct position in the opposite direction, and then bend them back to the perfectly straight position. This slight overstress of the rod before bringing it into the perfect position stabilizes the rod so that it will remain straight without any tendency to return to its previous shape.

If there is excessive wear on the connecting rod bearings, they should be replaced in order to reduce the burden on the piston rings. The need for new bearings is determined by running a bearing oil leak test as explained on page 3.

From a micrometer measurement of the crankpins, the correct undersize of the new rod bearings can be obtained. (Fig. 13c.)

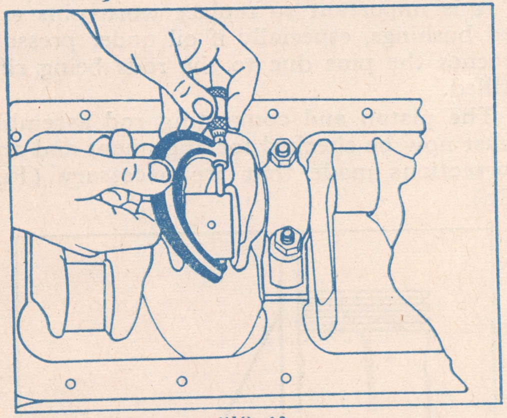


FIG. 13c

Some mechanics close the spurt hole in the connecting rod to reduce the amount of oil reaching the cylinder walls. Bear in mind, however, that with an installation of severe type spring rings, this practice may reduce to a danger point the oil flow to the cylinder walls. This of course might result in overheating, ring wear, seizure, scoring, etc.

On jobs where new bearings are put into rods and you find the spurt holes closed from a previous ring installation, remember that they must be opened. Otherwise there may not be enough oil thrown off from the sides of the new bearings to afford sufficient lubrication to the cylinder walls and ring belt.

The large end of the rod forging must be absolutely clean, also round and to the correct diameter, so that the bearings will have complete contact which insures good heat transfer. Use fine emery cloth to remove all carbon and lacquer deposits.

In order to prevent oil from reaching the combustion chamber due to extreme clearances between the valve stem and valve guide, a valve packing should be installed. Or better still, install new valves or valve guides or both. In any case, the valves should be reconditioned.

On overhead valve engines it is important that the drain be kept open at all times, otherwise the oil level is raised in the valve alley and there is more likelihood that the surplus oil will reach the combustion chamber by way of the valves and valve guides.

Also in the case of these overhead valve engines, a small groove or notch cut in the rocker arm will prevent the oil from dropping directly on the end of the valve guide, and thus prevent an excess of oil from reaching the valve alley where the valve stems and valve guides are worn (Fig. 15).

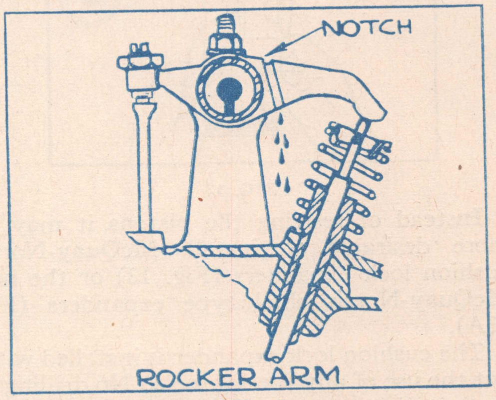


FIG. 15

Now you are ready to fit the rings and reassemble the motor. Check each ring in the cylinder to determine the amount of end clearance (Fig. 16).

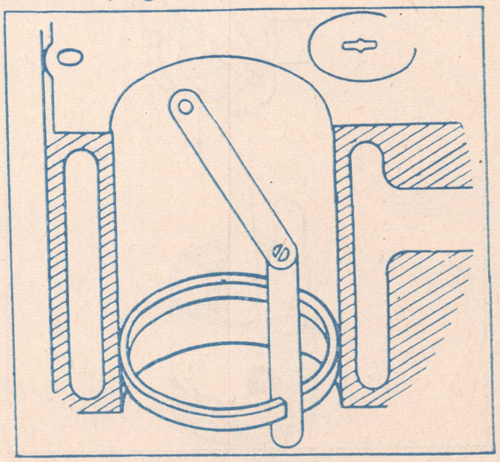


FIG. 16

The end clearance should never be less than thirty-five ten thousandths (.0035) of an inch per inch of cylinder diameter on rings up to four inches in diameter. On rings above four inches in diameter use a minimum end clearance of four thousandths (.004) of an inch per inch of cylinder diameter.

Where any fitting is necessary, use any of the several tools designed for this purpose (Fig. 17).

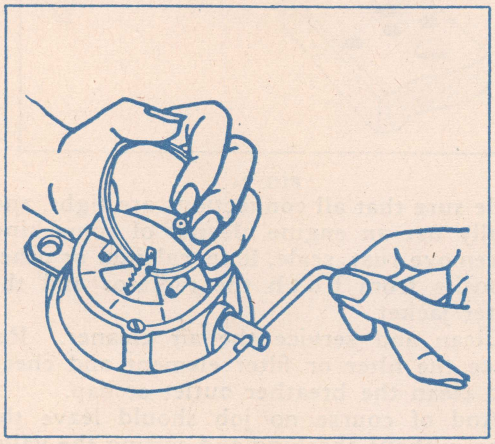


FIG. 17

If no tool is available, clamp the ring in a vise, so that the end of the ring is just above the vise top. Then with a file take many light cuts, being careful not to twist the ring or distort it in any manner. Always fit the ring to the smallest cylinder diameter (usually just below the lower end of the ring travel).

Piston rings must have sufficient side clearance in order to keep them from binding in the grooves and consequently becoming sluggish in their action, increasing both blowby and oil consumption.

On aluminum pistons, from one and one-half to two thousandths (.0015 to .002) of an inch is sufficient side clearance in the top groove and from one to one and one-half thousandths (.001 to .0015) in the lower grooves.

On gray iron pistons, two to two and one-half thousandths (.002 to .0025) of an inch is sufficient in the top groove and from one and one-half to two thousandths (.0015 to .002) in the lower grooves.

There are certain truck and tractor pistons where the motors are worked extremely hard, under high temperatures, on which three to four thousandths (.003 to .004) side clearance will give the best results.

While in most cases these clearances are allowed by the manufacturer in the machining of the piston grooves and the rings, they should nevertheless be checked on each installation. Feeler gauges are the most convenient for measuring the amount of side clearance (Fig. 18).

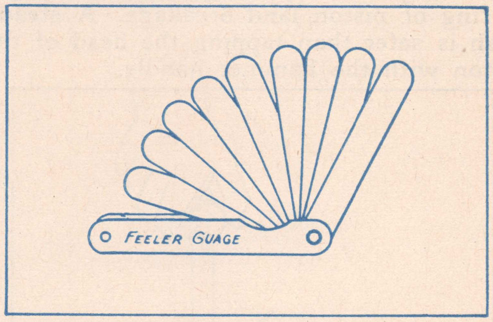


FIG. 18

If the side clearance is insufficient, the ring should be rubbed lightly on a piece of fine emery cloth laid on a surface plate (Fig. 19).

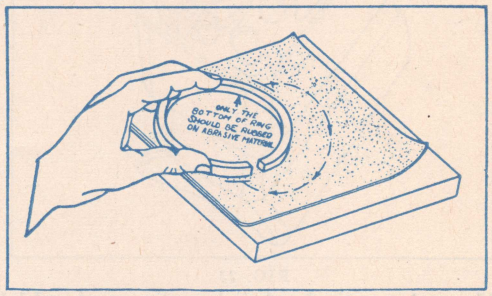


FIG. 19

It should be faced down until the proper feeler gauge (Fig. 20) can be inserted between the side of the ring and the side of the groove when the ring is in the free state (not closed).

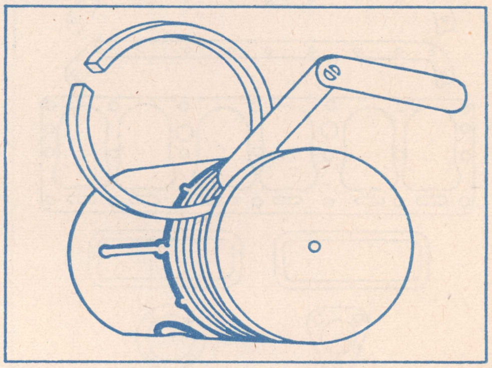


FIG. 20

Now the piston assemblies are ready for installation in the cylinder block. But first, all carbon, sludge, grit and metallic particles must be cleaned out of the cylinder bores, manifolds, crankcase, valve alley and pan. Soap and hot water or a good commercial cleaner should be used.

Reringing—*Continued*

For convenience in installation and in order not to damage the rings, a ring compressor should be used (Fig. 22). Use one that will enter rings into cylinders without danger of ring or piston land breakage. A steady push is safer than tapping the head of the piston with the hammer handle.

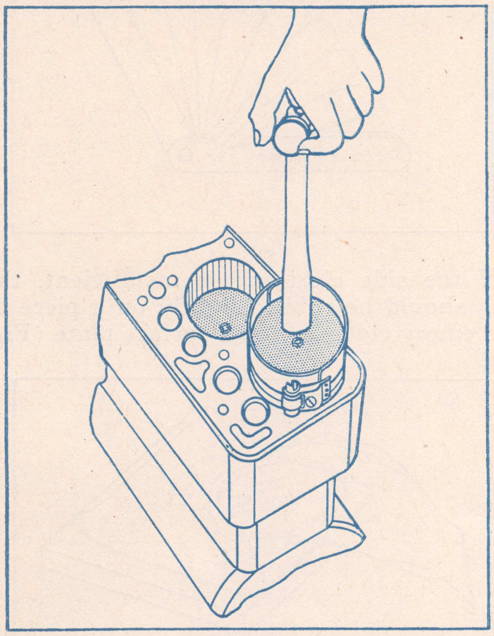


FIG. 22

Next the cylinder head and pan should be bolted in place. Always use new gaskets to insure against oil leaks, compression leaks, and water leaks (Fig. 23).

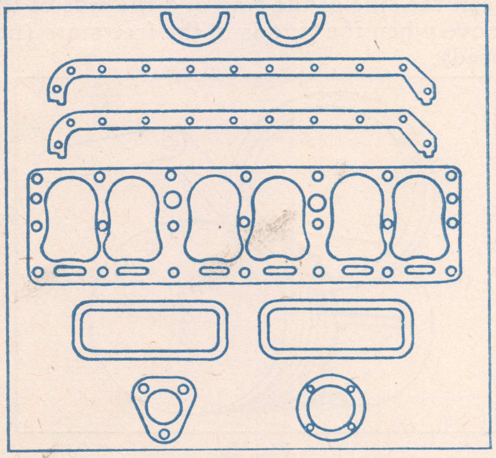


FIG. 23

The price of the gaskets is cheap insurance against comebacks.

The uneven drawing down of the cylinder head on the block is a cause of cylinder and cylinder head distortion which materially affects the performance of the piston rings and valves in controlling both blowby and oil. In order to avoid this trouble, use a tension indicating wrench and uniformly tighten every head bolt or nut in the proper sequence and to the tension specified by the car manufacturer (Fig. 24).

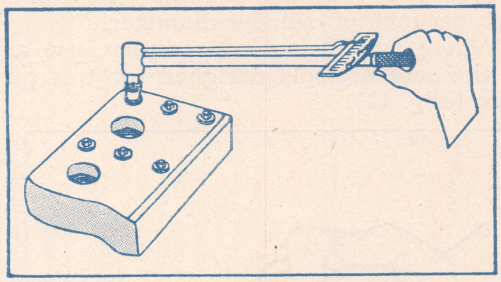


FIG. 24

Be sure that all connections are tight, and finally use an engine cleaner of some kind to remove rust, scale, lime, calcium or other deposits from both the radiator and the water jacket.

Clean and service the air cleaner. Replace the filter or filter element and check and clean the breather outlet or cap.

And of course no job should leave the shop without checking and setting the valve and ignition timing and seeing that the carburetor is adjusted properly, as both ignition and carburetion affect not only the gasoline consumption and efficiency of the motor but also the oil used and its lubricating qualities. Use a timing light in order to make this check (Fig. 25).

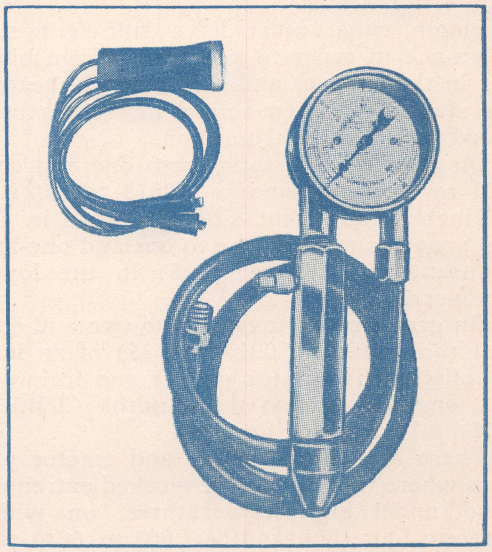


FIG. 25

Then use the McQuay-Norris Compression-Vacuum Tester (Fig. 25) to show the car owner the improved motor performance.

A short run-in at a speed that will maintain normal oil pressure is desirable. Be sure that motor oil has a safe viscosity. Do not use too thin an oil.

RERINGING—SUMMARY

The operation in Reringing can be summarized as follows:

Remove ridge at top and bottom of ring travel.

Clean carbon from ring grooves and oil drain holes.

Cut groove or chamfer below oil ring groove located above pin hole and drill additional drain holes.

Drill additional oil drain holes below pin hole in solid skirt pistons.

Check land clearance and recut lands if necessary.

Expand pistons by resizing or install piston expanders, or both.

Replace worn pins and rod bushings especially when rods are rifle drilled.

Install new connecting rod bearings if necessary.

Clean large end of rod forging to insure good bearing contact.

Align piston and connecting rod assembly.

Fit and install rings.

Install valve guides or valve packing.

Recondition valves.

Thoroughly clean piston assemblies, cylinders, manifolds, crankcase, valve chamber and pan just before putting motor together.

Install new gaskets.

Clean radiator and water jacket.

Clean and service air cleaner.

Replace filter or filter element.

Check and clean breather outlet or cap.

Check and correct carburetion, valve and ignition timing.

Make final check with Compression-Vacuum Tester and Bearing Oil Leak Tester.

Run-in motor at a speed that will maintain normal oil pressure.

NECESSARY TOOLS

Cylinder Gauge
Inside and Outside Micrometers
Ridge Remover
Cylinder hone.
Groove Cleaner
Land Tool
Chamfering Tool and Drill
Piston Resizer
Pin hole grinder or hone.
Rod Aligner
Feeler Gauges
Ring Filer
Ring Compressor
Valve Seat Grinder and Refacer
Guide Puller
Tension Indicating Wrench
Timing Light
Compression-Vacuum Tester
Bearing Oil Leak Tester

RECONDITIONING

RECONDITIONING means primarily the refinishing of the cylinders and the installation of new pistons, piston pins and piston rings. There are, of course, more things to be done than this in order to insure maximum efficiency of the parts installed and to give guaranteed satisfaction to the car owner. It is a more costly job than re-ringing and consequently should be done on motors where the owner is more particular, where the car is being used for extended trips, or on commercial jobs.

The refinishing of the cylinders can be done either in or out of the chassis (Fig. 26).

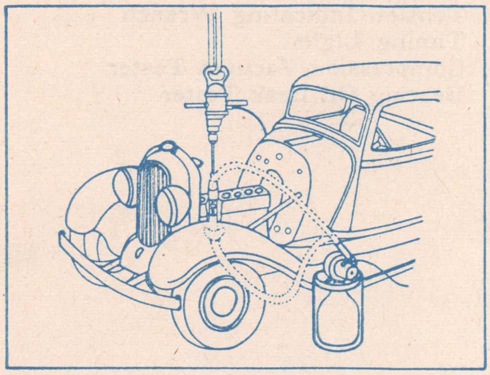


FIG. 26

If the engine is to be removed from the chassis, then the first operation in cylinder refinishing can be done either with an internal grinder or with a boring bar (Fig. 27).

If the refinishing of the engine is to be done in the chassis, a boring bar, handled properly, will give very good results. Where a boring bar is used, it is preferable to use one of the fly cutter type.

In preparing the engine for cylinder reconditioning, the safest precaution against abrasive wear is to tape shut the crankpin oil holes and the clearance at the ends of the main bearings.

Straightness and roundness and the proper alignment of the cylinders with each other and with the crankshaft are the important factors to consider. In order to accomplish this, the top of the block should be cleaned of all rust and carbon. Use a large mill file, holding the handle in one hand and pressing down on the center of the file with the other. File the block as flat as possible before centering the boring bar.

In centering the boring bar, the cat's paws should be run down into the cylinder

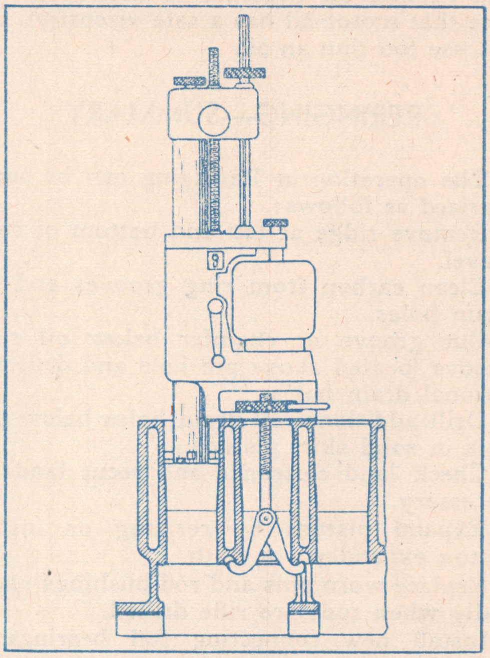


FIG. 27

to a point below the ring travel where the wear is seldom more than two or three thousandths (.002 or .003) of an inch.

Smoothness of the cylinder wall is necessary for the satisfactory operation of the pistons and rings. While it is possible to get a fairly good finish by boring, because of the fact that any boring bar cuts a thread no matter how fine its feed may be, the better method of finally finishing the block is by honing.

In setting the boring bar cutter for finishing with a hone, allow approximately one thousandth (.001) of an inch under the desired cylinder diameter which is enough for the hone to clean up serrations left by the cutter and to improve the cylinder finish. Remove this allowance using stones in the hone having a grit of 280, 300 or 320. The 320 grit is safest to use but the coarser faster cutting 280 grit will also do a good job if care is exercised to remove only the .001 allowed for honing.

Dry honing produces a satisfactory finish but is only recommended when suction equipment is available to prevent the dust containing grit and metal cuttings from getting into the manifolds, valve alley, etc.

The most satisfactory cylinder finish results from squirting or running kerosene on the stones during the honing operation. Kerosene keeps the stones cutting free and prevents any abrasive dust from forming.

Reconditioning—*Continued*

Both methods must be followed by thorough cleaning. The finish so produced will not cause excessive wear of new piston rings but will hold an oil film and gently seat in the ring faces so that a seal of oil and blowby will be maintained from the start.

Most failures in reconditioned motors develop because the cylinder walls and other parts are not thoroughly cleaned of chips, iron dust, abrasives, etc. The presence of any such material in the assembled motor causes quick wear of the cylinders, rings, pistons, pins, bearings and other internal parts because it is soon picked up by the oil and pumped through the lubricating system.

A thorough cleaning job should start with the use of a suction or exhaust system where either an internal grinder or a boring bar is used. This equipment will prevent cast iron chips or dust and abrasive from getting into pockets and crevices in the crankcase, from which it is very difficult to remove them.

An added precaution is to tape the throws of the crankshaft in order to keep any foreign matter out of the oil holes.

Rubber cups are used extensively to catch the cuttings from the boring bar. A vacuum suction system must be used during dry honing, and in wet honing care should be taken not to use an excessive amount of lubricant.

Next, before the engine is placed in the chassis or before any reassembling is done, the cylinder walls should be scrubbed with a strong soap and water solution (Fig. 28).

The soap and water solution will work faster and more thoroughly if used hot. Heavy oils and grease can also be used with good results. Light liquids like gasoline or kerosene will not do the job, due to the fact that they do not have sufficient adhesive properties to gather the fine particles of abrasive.

If the final cleaning operation is done very long before installation of the piston assemblies, the head and pan should be put on with a few bolts to keep dust and grit from blowing or falling into the motor.

The first step in preparing the piston assemblies is to select the proper pistons and see that they are finished to the correct size and shape. (Fig. 29).

Cam grinding protects both cast iron and aluminum pistons against scuffing and permits a little tighter fit which results in quieter operation and better oil mileage. The bottom edge of the piston skirt should never be chamfered because a sharp edge aids in oil control.

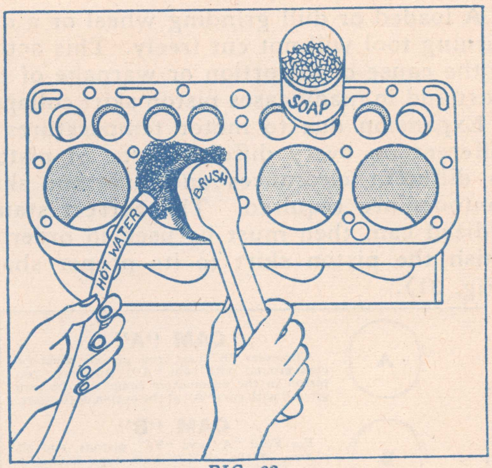


FIG. 28

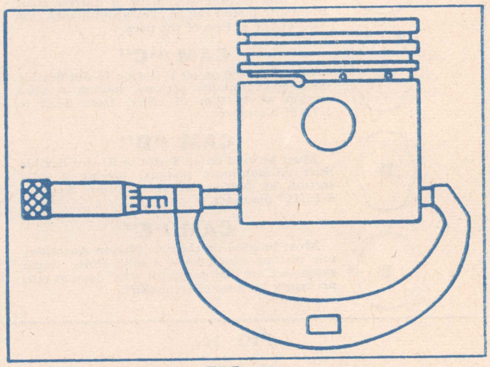


FIG. 29

The finish of the skirt and the shape of the skirt are both important. The piston grinding and turning machine used for the refinishing of the pistons must be equipped with a cam grinding attachment (Fig. 30).

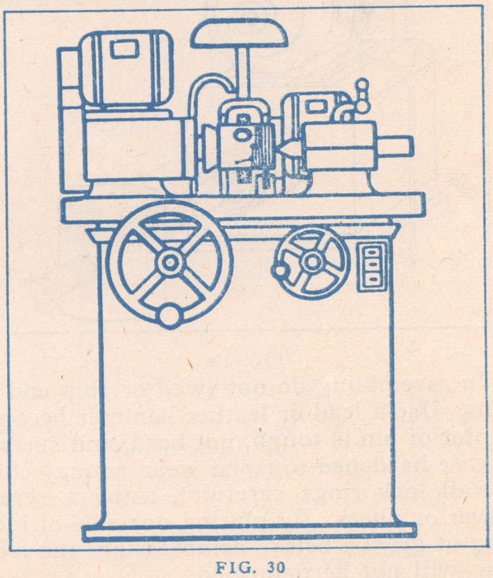
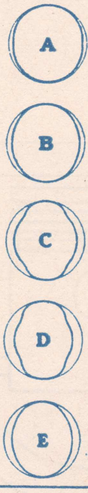


FIG. 30

A loaded or dull grinding wheel or a dull turning tool will not cut freely. This action is the cause of distortion or warpage of the skirt and in many cases piston skirt collapse.

Expansion due to motor temperatures is different on every different type of piston, so different clearances and different skirt contours are required. The correct standardized cam then must be used in order to finish the piston skirt to its proper shape (Fig. 31).



CAM "A"

Chevrolet "6" cast iron pistons must be cam ground with cam "A". Any cast iron piston in the automotive range can be cam ground with cam "A" at the option of the user.

CAM "B"

For Ford "A" and "V8" pistons, and all pistons of the all-aluminum type having a split skirt completely open from top to bottom. Any Nelson wide strut or narrow strut Bohnalite piston can be cam ground with cam "B" at the option of the user.

CAM "C"

Must be used on all T-slot or U-slot flexible skirt all-aluminum pistons, having a solid section at bottom of skirt, from 2¾" to 3-7/16" diameter.

CAM "D"

Must be used on all T-slot or U-slot flexible skirt all-aluminum pistons, having a solid section at bottom of skirt, from 3½" to 4-15/16" diameter.

CAM "E"

Must be used on the new Nelson Autothermic pistons which have a solid skirt. Same shape as Cam "B" but with .013" drop at pin, necessary because of solid skirt.

FIG. 31

Hone or ream to fit pins in new rod bushings (Fig. 31a).

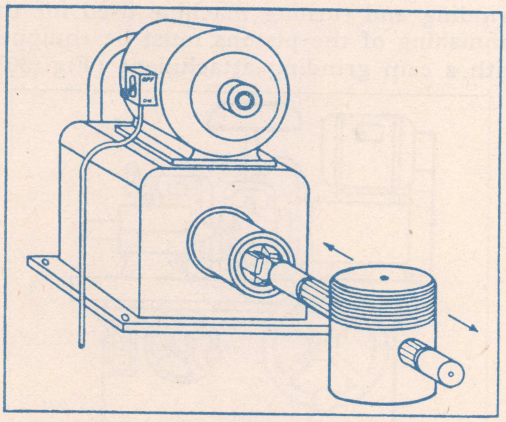


FIG. 31a

In assembling do not swell or chip end of pins. Use a lead or leather hammer because center of pin is tough, not hard, and surface is case-hardened to resist wear, so may chip. Install lock rings carefully, using a screw driver or pliers. By placing one side of lock ring in groove before compressing, the lock ring will not be deformed.

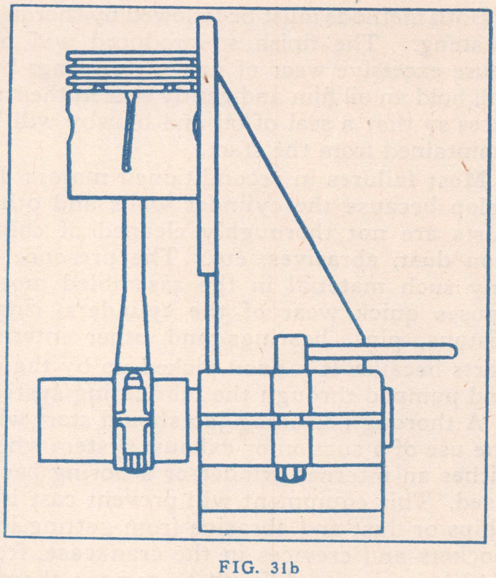


FIG. 31b

The next step is to check this assembly for alignment. It isn't sufficient merely to check the connecting rod by itself for alignment. The entire piston assembly should be checked, first, for alignment taken between the piston skirt and the crank-pin bearing hole of the connecting rod; second, for twist in the connecting rod; and third, for offset of the connecting rod (Fig. 31b).

Where the assembly is not correctly aligned, and it is necessary to straighten the rods, the best practice is to bend them slightly beyond the correct position in the opposite direction, and then bend them back to the perfectly straight position. This slight over stress of the rod before bringing it into the perfect position stabilizes the rod so that it will remain straight without any tendency to return to its previous shape.

The type of rings decided upon should now be fitted to each cylinder (Fig. 32).

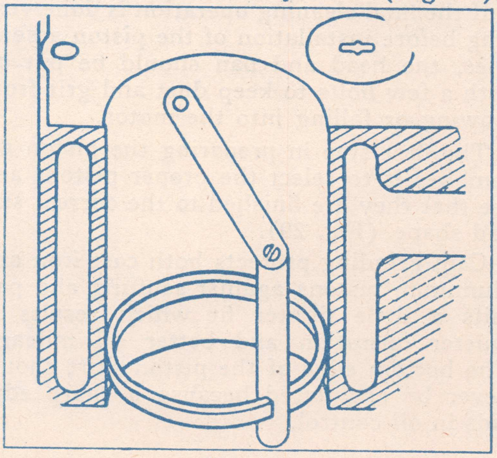


FIG. 32

While there are many who use non-expander type rings such as our Factory Type Set, a more common practice, guaranteeing the best results, is to use Rebore-Rebuild Sets.

The end clearance should never be less than thirty-five ten thousandths (.0035) of an inch per inch of cylinder diameter in cylinders up to four inches in diameter. Use four thousandths (.004) of an inch per inch of cylinder diameter in all cylinders over four inches in diameter

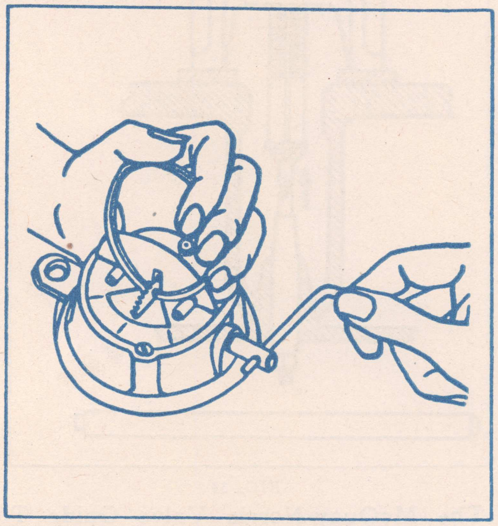


FIG. 33

Where any fitting is necessary, use any of the several tools that have been designed for this purpose (Fig. 33), or if no tool is available, then clamp the ring in a vise so that the end of the ring extends just above the vise top. Take many light cuts with a file, being careful not to distort or twist the ring. Fit the ring to the smallest cylinder diameter.

Piston rings will not function satisfactorily unless they have the proper side clearance. Wherever a ring binds sideways in the groove its action becomes sluggish and it does not exert its full tension against the cylinder wall.

On aluminum pistons, from one and one-half to two thousandths (.0015 to .002) of an inch is sufficient side clearance in the top groove and from one to one and one-half thousandths (.001 to .0015) in the lower grooves.

On gray iron pistons, two to two and one-half thousandths (.002 to .0025) of an inch is sufficient in the top groove and from one and one-half to two thousandths (.0015 to .002) in the lower grooves.

There are certain truck and tractor pistons where the motors are worked extremely hard, under high temperatures, on which three to four thousandths (.003 to .004) of an inch will give the best results.

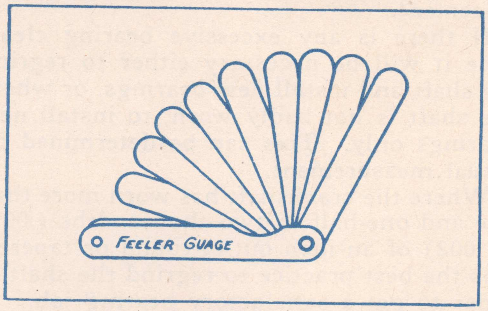


FIG. 34

A feeler gauge is most convenient for measuring the amount of side clearance (Fig. 34). If it is found that the side clearance is insufficient the rings should be rubbed lightly on a piece of fine emery cloth held on a surface plate (Fig. 35).

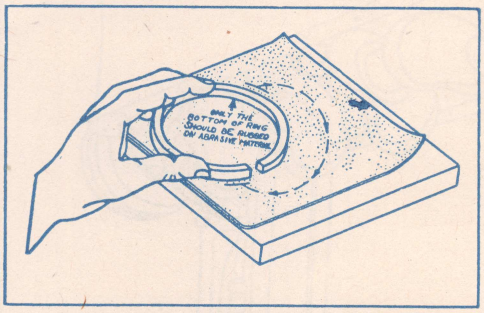


FIG. 35

Remove sufficient material to allow the proper feeler gauge to be inserted between the side of the ring and the side of the groove when the ring is in the free state (Fig. 36).

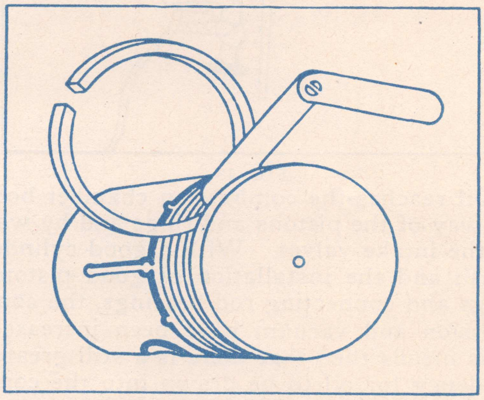


FIG. 36

Reconditioning—*Continued*

Since the efficiency of a set of piston rings depends not only upon the design of the rings and the condition of the piston assembly, but also upon the amount of oil reaching the rings, it is very important that excessive oil throw-off from worn rod and main bearings be eliminated by bearing replacement.

If there is any excessive bearing clearance it will be necessary either to regrind the shaft and install new bearings, or where the shaft is not badly worn, to install new bearings only. This can be determined by actual measurement.

Where the crankshaft has worn more than one and one-half to two thousandths (.0015 to .002) of an inch out-of-round or tapered, it is the best practice to regrind the shaft in order to get a satisfactory bearing job.

A portable crankshaft regrinding machine can be used for this operation (Fig. 37). It is most serviceable when a crankpin has been damaged by a bearing burning out. The journal can be ground smooth and fitted with a special undersize rod bearing.

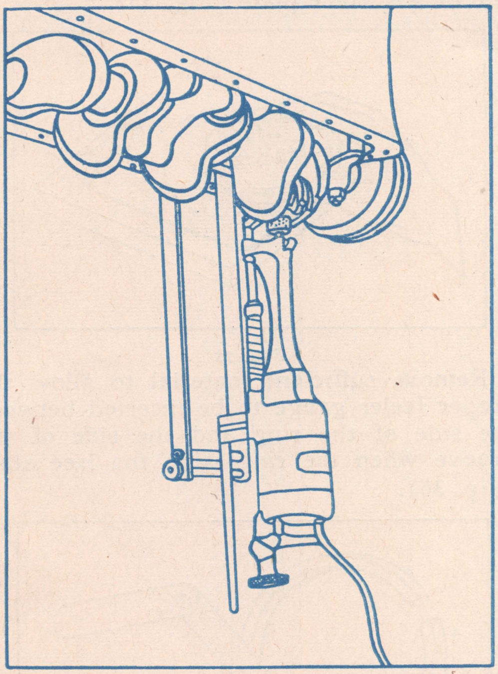


FIG. 37

Oil reaches the combustion chamber both by way of the pistons and rings and by way of the intake valves. With a good cylinder finish and the installation of good pistons, rings and connecting rod bearings, the compression and vacuum have been increased. This means then that there is a still greater tendency for oil to be drawn into the combustion chamber by way of the intake valves than there was previously, so in order to assure your customer full satisfaction, the valve guides and valves should both be replaced.

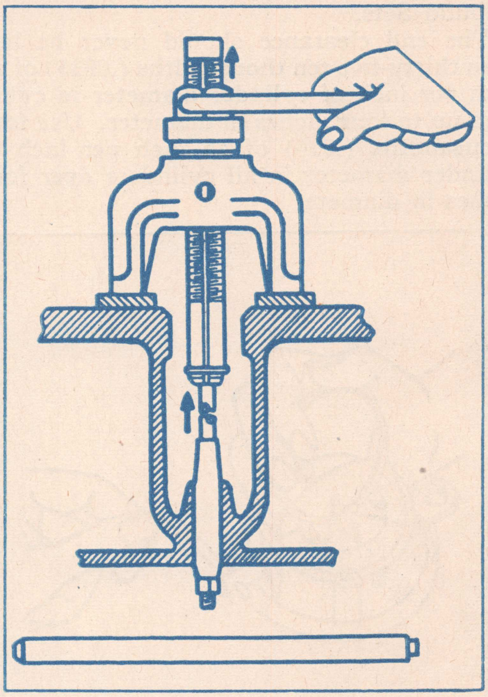


FIG. 39

The McQuay-Norris Valve Guide Tool (Fig. 39) should be used in removing and installing the valve guides.

Weak valve springs are also a source of trouble in that they allow more oil vapor to reach the combustion chamber. Weak springs may also decrease the stability of the valves, causing additional wear on the valve stem and valve guide. For this reason the valve springs should be checked with a valve spring tester (Fig. 40).

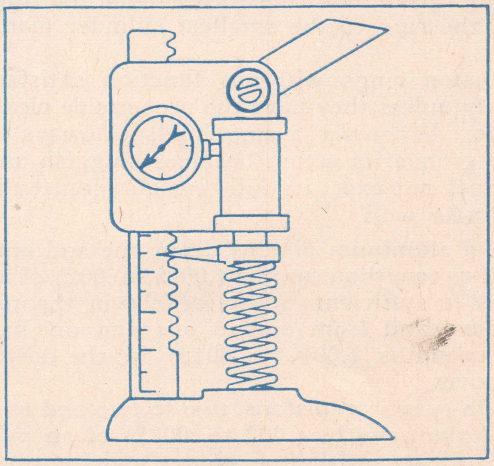


FIG. 40

The proper loadings for different valve springs are listed in the McQuay-Norris Chart of Valve Spring Loads and Lengths. Some valve springs are designed with several coils more closely wrapped at one end for the purpose of dampening out vibration and surging. These springs must be installed with the closely wrapped coils against the block of an "L" type motor or against the head of a valve-in-head motor, otherwise spring breakage will occur.

Leakage of oil from both the front and rear main bearings should be checked very carefully, and if such leakage exists the drain holes should be cleaned, or if the wear on the bearings is excessive, new bearings should be installed. Always install new seals at front and rear mains.

The process from here on is the same as in reringing. Install piston assemblies, using a ring compressor that will enter rings into cylinders without breakage of rings or piston lands. A steady push with a hammer handle is safer than tapping the piston head (Fig. 41).

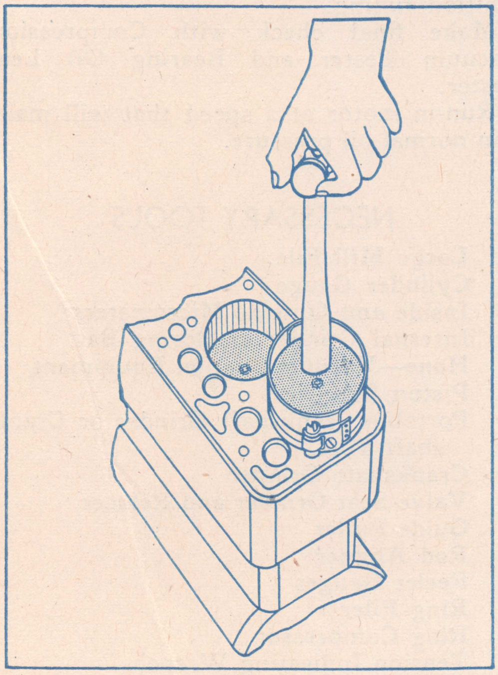


FIG. 41

The cylinder head and pan should next be replaced, using new gaskets in order to insure yourself against any oil leaks, compression leaks, and water leaks (Fig. 42).

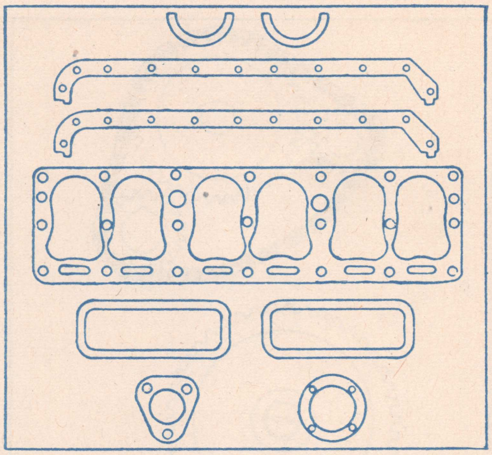


FIG. 42

Due to the seriousness of cylinder distortion, a tension indicating wrench should be used for tightening down the head bolts (Fig. 43).

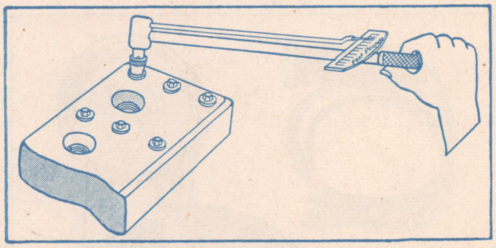


FIG. 43

The motor now approximates its mechanical condition when new, but to operate to its full efficiency it must operate at a uniform normal temperature. Both the radiator and the water jacket must be thoroughly cleaned of rust, scale, lime, calcium and other deposits by using a good engine cleaner for this purpose.

Clean and service the air cleaner. Replace the filter or filter element and check and clean the breather outlet or cap.

Now before the job is ready for the owner, the ignition and valve timing should be checked and corrected. A worn timing gear or chain should be replaced (Fig. 44).

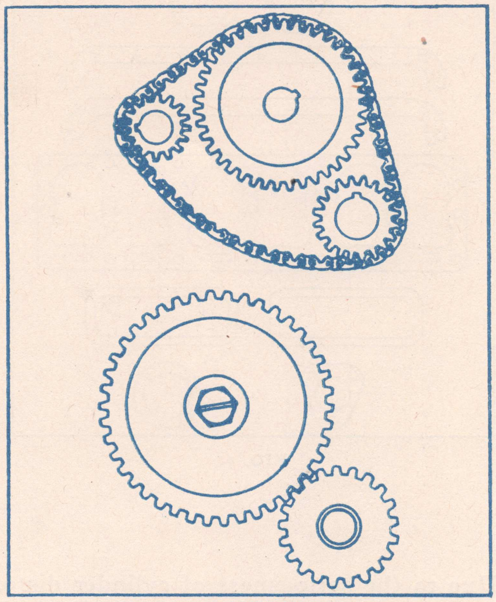


FIG. 44

The carburetor should be adjusted properly and worn parts such as the jets replaced. Poor carburetion affects not only the gasoline consumption and efficiency of the motor, but also the amount of oil used and its lubricating quality.

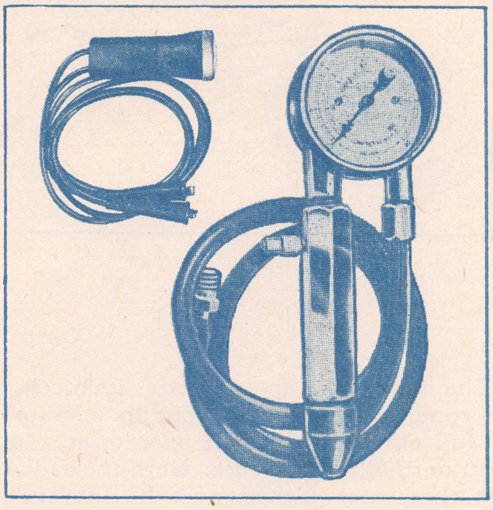


FIG. 45

And now make your final check with the use of a timing light and the McQuay-Norris Compression-Vacuum Tester (Fig. 45), preferably in the presence of the car owner so that he can see with his own eyes the improved motor performance.

Run-in the motor with the quantity and viscosity of oil recommended by the car manufacturer for a new motor.

RECONDITIONING—SUMMARY

The operations involved in Reconditioning can be summarized as follows:

Clean and dress down top of block using a sharp mill file.

Refinish cylinders.

Clean cylinders and other parts of the motor of any iron dust, chips or abrasive.

Grind pistons.

Fit pin to new rod bushings.

Assemble piston and connecting rod and align entire assembly.

Fit rings to cylinders.

Install new bearings.

Install piston and connecting rod assembly.

Install new valve guides and grind valve seats.

Install new valves, valve springs and keepers.

Install new gaskets.

Clean radiator and water jacket.

Clean and service air cleaner.

Replace filter or filter element.

Check and clean breather outlet or cap.

Check and correct carburetion, valve and ignition timing.

Make final check with Compression-Vacuum Tester and Bearing Oil Leak Tester.

Run-in motor at a speed that will maintain normal oil pressure.

NECESSARY TOOLS

Large Mill File.
Cylinder Gauge
Inside and Outside Micrometers
Internal Grinder or Boring Bar
Hone—Vacuum Suction Equipment
Piston Grinder
Portable Crankshaft Grinder or Crankshaft Tool.
Crankshaft Grinder
Valve Seat Grinder and Refacer
Guide Puller
Rod Aligner
Feeler Gauges
Ring Filer
Ring Compressor
Tension Indicating Wrench
Timing Light
Compression-Vacuum Tester
Bearing Oil Leak Tester

REBUILDING

MOTOR reringing and motor reconditioning are partial jobs. Motor rebuilding is the most complete job of all, the term generally implying a complete replacement of all wearing parts.

Motor rebuilding is old. Many shops throughout the country have specialized in the complete overhauling or the complete rebuilding of a motor for years. It has always been a very costly job since it covers the replacement of all wearing parts. This fact, however, means that when a motor is completely rebuilt it approximates its condition when new and so approximates its performance when new.

The term motor rebuilding as we are interested in it today has a slightly different meaning. It really should be called production motor rebuilding. The thoroughness and completeness of the job is the same as it was in the past, but the cost has been materially reduced. This has all been accomplished by putting motor rebuilding on a production basis, using modern production methods with the necessary tools and fixtures for rebuilding a motor complete in the minimum of time.

There are two general plans to follow. The decision on which plan to use depends largely on the shape and size of the floor space available.

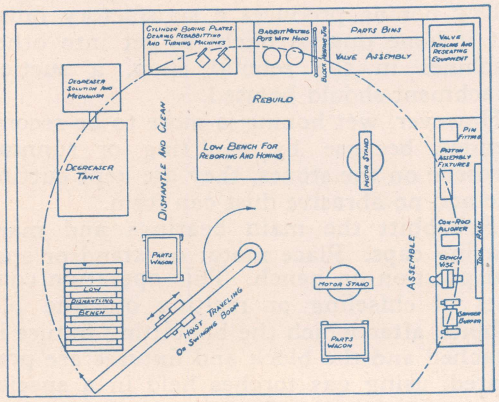


FIG. 46

The first plan is the use of a swinging boom type crane. By the use of this type crane the production line can be laid out in a space approximately 20x25 feet (Fig. 46).

The second plan is the use of an overhead track. By the use of such a track, the production line could be laid out in a space approximately 10x50 feet (Fig. 47).

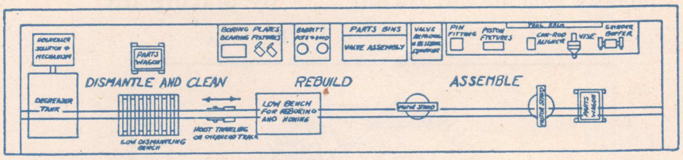


FIG. 47

It is generally understood that good tools are necessary on any job, and this is true in production rebuilding. The most important thing, however, in a production rebuilding line is the handling of the work in process. This is the difference between an ordinary rebuilding job and a production rebuilding job, and is to a great extent responsible for the lowered cost.

Using either the swing boom type crane or the overhead track, block and tackle, electric or air hoists are necessary for the quick handling of the work. The choice here simply depends upon the amount of work and power available.

The work must be held while the operations are being performed. Here motor stands are usually used. However, a bench of suitable height and length for each operation with angle iron slide rails and a revolving section for valve work can be specially constructed.

Since this is a production job where several motors may be worked upon at the same time, it is most important that the parts from each motor are kept separate. Parts wagons of sufficient size are used for this purpose.

Cleaning equipment such as a washing machine, degreaser or gun type cleaner is necessary. This is possibly a little more elaborate than is regularly used in the average shop, but remember this is production rebuilding, and the speed of cleaning as well as all other operations is most important.

In order to illustrate more clearly such a production rebuilding line, we are setting up a production line for Ford V8, describing each operation together with the equipment, tools and fixtures necessary. The principles involved in the Ford V8 production line, however, can be applied to any other popular motor. Generally speaking, the only changes necessary are some adjustments of the tools and special clamps and fixtures for holding each particular motor. The one thought to be borne in mind is that for a production line to be highly profitable there must be a sufficient volume of work.

Rebuilding—*Continued*

Dismantle motor. This operation is done on a bench of approximately two feet in height, with a slat top in order to allow the heavy dirt to fall through, or by placing the engine in a motor stand (Fig. 48).

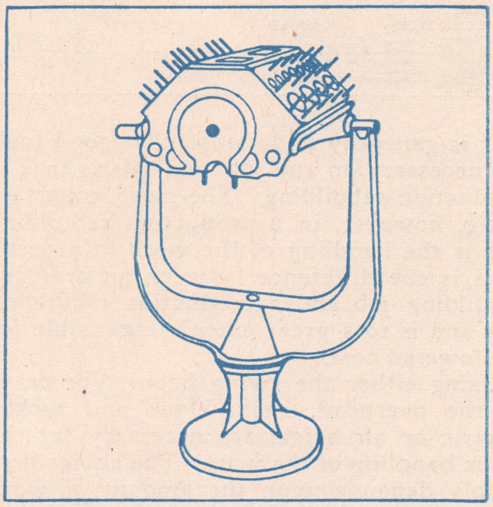


FIG. 48

The operation can be speeded up by the use of air or electric wrenches. These tools are available from the manufacturers of electric and air drills.

Clean or degrease the engine and parts. This operation is done in a chemical degreaser or washing machine (Fig. 49) or with a gun-type cleaner. The usual washing or degreasing operations do not always remove the rust, scale, lime, calcium and other deposits from the water jacket, and it is advisable to use a special engine cleaner of some kind for this purpose.

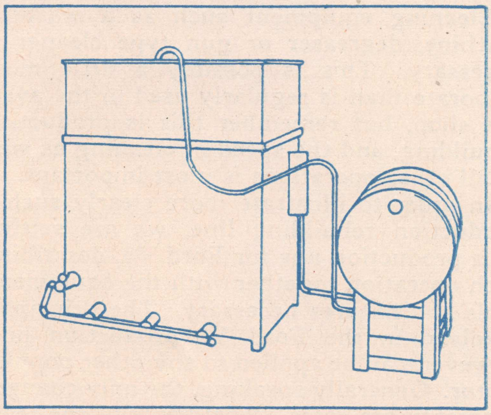


FIG. 49

Inspect the block for cracks, welds, low valve seats, cylinder scores, oversize of cylinders, condition of cam bearings, maximum undersize of crankshaft, together with the condition of all the used parts that may possibly go back into the finished engine.

Rebore the cylinders. A fly-cutter type boring bar is used in conjunction with a production boring plate that overcomes the necessity of removing the cylinder head studs (Fig. 50).

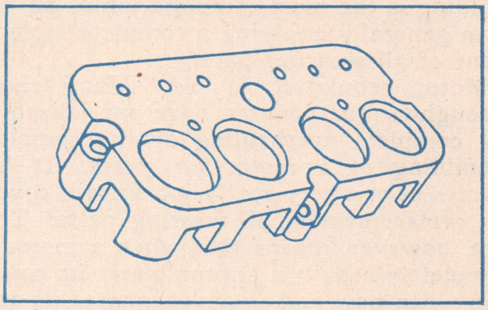


FIG. 50

A special motor stand is generally used for holding the banks of the block vertical. This type of stand is not only available on the market, but is relatively easy to construct.

In order to produce a cylinder finish that will hold an oil film and gently seat the new rings, it is necessary to use a cylinder hone following the boring bar.

It is recommended that stones either 280, 300 or 320 grit be used in the hone for this operation. An allowance for honing of one thousandth (.001) of an inch under the desired cylinder diameter will permit cleaning up the serrations from the boring bar cutter and improving the cylinder finish.

Dry honing produces a satisfactory finish but if hone dust is likely to get into other machines in the rebuild shop, a suction attachment should be used.

However, wet honing is more to be recommended because by squirting or running kerosene on the stones, they are kept cutting free and no abrasive dust can form.

Rebabbitt the main bearings and main bearing caps. Place motor on stand or special position on bench. This operation consists of chiseling or melting out the old babbitt, after which the babbitting fixture is attached and the block and fixtures are preheated, using gas torches held in a special fixture so that the flame heats the desired portion of the block. New babbitt is poured in the block, and the caps are also placed in fixtures, preheated, and the new babbitt poured into the caps. An extra supply of caps may be kept on hand and rebabbitted in advance.

Line bore main bearings and caps (Fig. 51). Motor is kept on stand or in special position on bench.

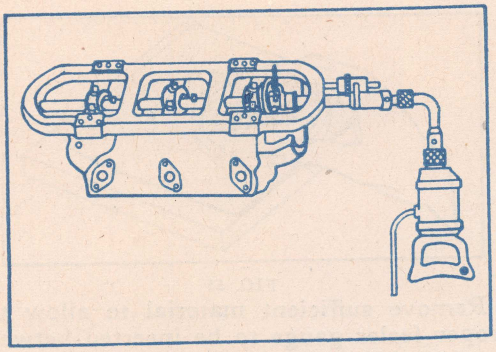


FIG. 51

This operation consists of assembling the caps to the case, fitting in position the line boring fixtures, setting the boring tools to bore the correct diameter for the crankshaft to be used. The line boring fixture is preferably driven with an electric drill and after the bar is fed through the bearings, the rear main bearing is faced before the fixture is removed and the finished bearings are checked for size with inside calipers or micrometer.

Grind valve seats and narrow the seat contacts to the correct width. Reface both ends of valve tappets. Cut new valves to correct length to give proper tappet clearance. Motor is placed on stand or in special bench position. Regular valve seat grinding equipment is used for the seat operations, with the addition of extra or special pilots in order to speed up this operation. Special measuring and control devices for grinding off the new valves for tappet clearance must be used to cut cost, and are available from most manufacturers of valve equipment.

Return motor to the cleaning department to remove chips and abrasive. If degreaser is used, cylinder bores should be scrubbed with soap and water after removing from the tank.

Install cam shaft bearings if needed. Motor is kept on motor stand or in special position on bench. Use a McQuay-Norris Cam Shaft Removing and Installing Tool (Fig. 52).

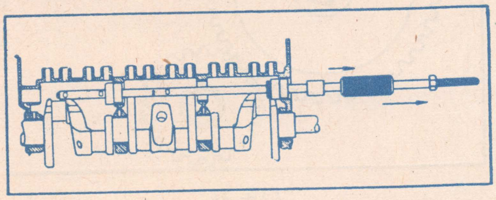


FIG. 52

Crankshaft grinding is not included in the regular production rebuilding line. It is generally done in advance by having on hand a number of finished crankshafts that are available for immediate use. Crankshafts are ground to the nominal standard of undersize connecting rod bearings available.

The larger or lower end of the connecting rod can best be remachined with a cylinder grinder. A soft, free-cutting wheel is used, the final polish being produced with a hone. Rods are remachined to fit oversize on the outside rod bearings with a clearance of .0015 to .0025", care being taken that the joint at the split line is relieved so as to prevent the sharp ridge from cutting the bearing. This is done with a file or a small grinding wheel.

The proper undersize and oversize insert connecting rod bearings should now be installed on the crankshaft.

Assemble cam shaft, crankshaft, fly-wheel, tappets, new valve guides, new valves, new valve springs and new keepers. Motor is kept on stand or in special position on bench. (Some types of valve equipment require the installation of the cam shaft and tappets previous to cutting new valves to correct length.)

Disassemble old pistons and bushings from the connecting rods and reassemble and fit new bushings, pins and pistons.

Return piston and rod assemblies to cleaning department to remove chips and abrasive.

Align the connecting rod assemblies (Fig. 53).

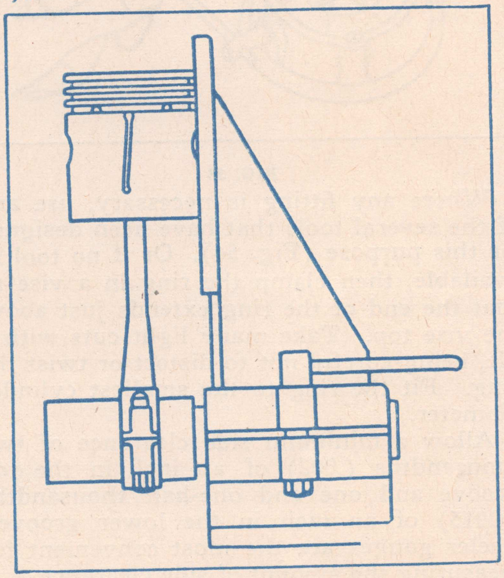


FIG. 53

It isn't sufficient merely to check the connecting rod by itself for alignment. The

Rebuilding—*Continued*

piston should be installed on the connecting rod and the entire assembly checked, first, for alignment taken between the piston skirt and the crank-pin bearing hole of the connecting rod; second, for twist in the connecting rod; and third, for offset of the connecting rod.

Where the assembly is not correctly aligned and it is necessary to straighten the rods, the best practice is to bend them slightly beyond the correct position in the opposite direction, and then bend them back to the perfectly straight position. This slight overstress of the rod before bringing it into the perfect position stabilizes the rod so that it will remain straight without any tendency to return to its previous shape.

Non-expander type rings may be used, or expander type Rebore-Rebuild Sets.

Fit piston rings to cylinder bores and to pistons. Rings should be selected of the proper oversize and fitted to the cylinders with a minimum end clearance of thirty-five ten thousandths (.0035) on an inch per inch of cylinder diameter.

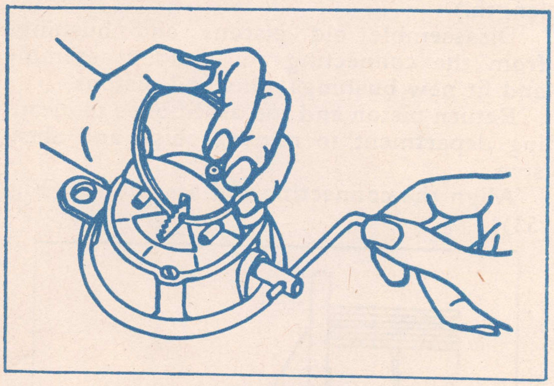


FIG. 54

Where any fitting is necessary, use any of the several tools that have been designed for this purpose (Fig. 54). Or if no tool is available, then clamp the ring in a vise so that the end of the ring extends just above the vise top. Take many light cuts with a file, being careful not to distort or twist the ring. Fit the ring to the smallest cylinder diameter.

Allow a minimum side clearance of two thousandths (.002) of an inch in the top groove and one and one-half thousandths (.0015) of an inch in the lower grooves. Feeler gauges are the most convenient for measuring the amount of side clearance.

If it is found that the rings have insufficient side clearance they should be rubbed lightly on a piece of fine emery cloth laid on a surface plate (Fig. 55).

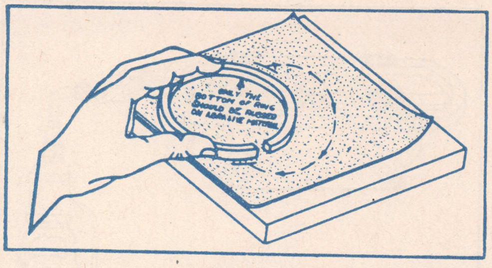


FIG. 55

Remove sufficient material to allow the proper feeler gauge to be inserted between the side of the ring and the side of the groove when the ring is in its free state (Fig. 56).

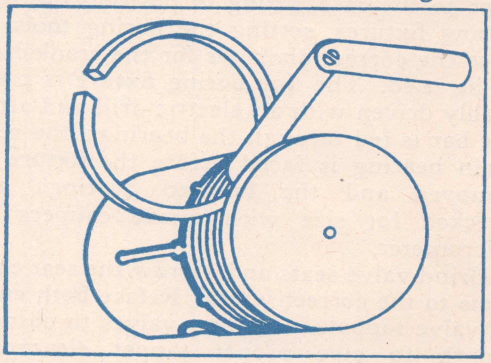


FIG. 56

Install pistons and rod assemblies.

Check old timing gears (Fig. 57). If more than five thousandths (.005) of an inch back lash is found, replace cam gears.

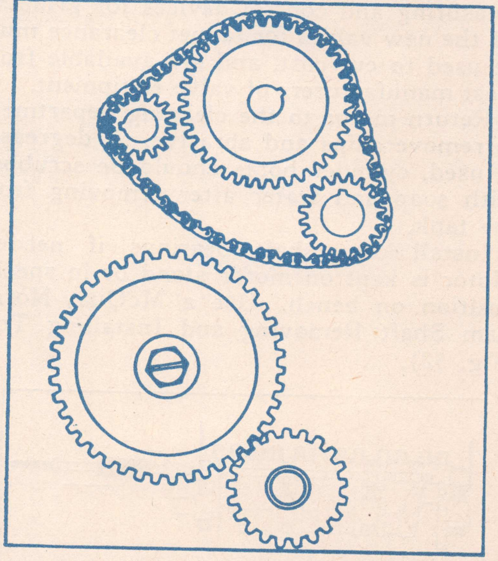


FIG. 57

Make final inspection. Assemble oil pan and front cover plate, and next install the head gaskets (Fig. 58), cylinder head and intake manifolds, using a tension indicating wrench.

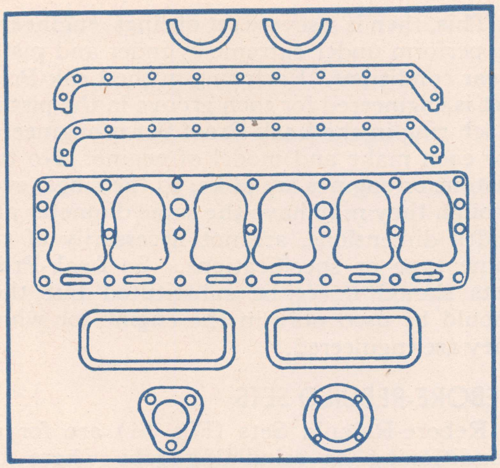


FIG. 58

The rebuilt motor must now be installed in the chassis. The water jacket was thor oughly cleaned during the rebuilding of the motor of any rust, scale, calcium, lime or other deposits. The radiator must also be thoroughly cleaned. Use a good engine cleaner and run water both ways until all foreign matter has been removed.

Clean and service the air cleaner. Replace the filter or filter element and check the breather outlet or cap for any foreign material. Make all electrical and other connections and you are now ready for the final adjustment.

Check and adjust the carburetor and the valve and ignition timing. Use your timing light, and your Compression-Vacuum Tester (Fig. 59).

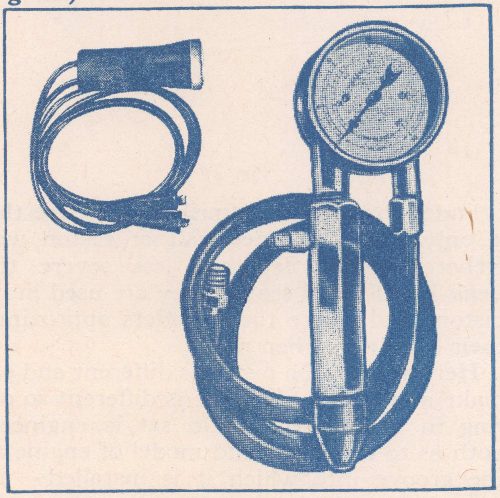


FIG. 59

After a short warm up at a speed that will maintain normal oil pressure and thereby insure adequate oil reaching the new parts, drive the car around the block a few times, and it is ready for delivery to the owner.

REBUILDING—SUMMARY

The operations involved in Rebuilding can be summarized as follows:

Refinish cylinders.
Clean cylinders and other parts of the motor of any iron dust, chips or abrasive.
Regrind crankshaft.
Replace main bearing inserts or rebabbitt.
Line bore main bearings if required.
Install new valve guides and grind valve seats.
Install cam shaft bearings.
Install new connecting rod bearings.
Install new valves, valve guides, valve springs and keepers.
Grind pistons, assemble with connecting rods and align entire assembly.
Fit rings to cylinders.
Install piston and rod assemblies.
Install new timing gears or chain.
Install new gaskets.
Clean radiator.
Clean and service air cleaner.
Replace filter or filter element.
Check and clean breather outlet or cap.
Check and correct carburetion, valve and ignition timing.
Make final check with Compression-Vacuum Tester and Bearing Oil Leak Tester.

NECESSARY TOOLS

Cylinder Gauge
Inside and Outside Micrometers
Swinging Boom Type Crane or Overhead Track
Block and Tackle or Electric or Air Hoist
Motor Stand or Bench
Parts Wagon
Washing Machine, Degreaser or Gun Type Cleaner
Internal Grinder or Boring Bar
Hone—Vacuum Suction Equipment
Piston Grinder
Crankshaft Grinder
Babbitting Equipment
Line Boring Fixture
Cam Shaft Bearing Puller
Valve Seat Grinder and Refacer
Guide Puller
Feeler Gauges
Ring Filer
Ring Compressor
Rod Aligner
Tension Indicating Wrench
Timing Light
Compression-Vacuum Tester
Bearing Oil Leak Tester

THE RIGHT RINGS FOR THE JOB

I have covered generally Reringing, Reconditioning and Rebuilding, briefly mentioning the parts that should be installed in each case. The choosing of the parts is of the greatest importance in guaranteeing satisfactory engine performance.

The selection of the proper rings to get the most efficient gasoline and oil economy, together with a minimum of blowby, used to be quite a problem. However, McQuay-Norris has eliminated this problem by engineering ring sets for each specific make and model of engine, type of job and type of service. There are Leak-Proof Sets to be used on reringing jobs, Rebore-Rebuild Sets to be used on reconditioning or rebuilding jobs and Chrome Rebore-Rebuild Sets to be used on heavy duty truck engines.

Each set is numbered and is to be used only in the engine for which it is specifically engineered. By exhaustive tests, the proper type of compression ring and the proper type of oil ring for each set was determined, with the correct specifications to insure satisfactory performance.

LEAK-PROOF SETS

Leak-Proof Sets (Fig. 60) are for Reringing jobs where no other work is done to the cylinders except to remove the ledge left at

FIG. 60

the top and bottom of the ring travel due to the action of the old set of rings, or the vertical ledge left on the cylinder where pinned rings were used previously.

This, then is a severe set of rings, engineered to perform under extreme cylinder and piston wear conditions. Each ring in the Leak-Proof Set is engineered for each groove in the piston. Each ring in the Leak-Proof Set is engineered for each make and model of engine. No two pistons or engines are alike, so the rings, even though they may have the same diameter and width dimensions, are not necessarily of the same type or specifications. So Leak-Proof Sets should never be substituted but they should be used only in the engine for which they are engineered.

REBORE-REBUILD SETS

Rebore-Rebuild Sets (Fig. 61) are for reconditioning or rebuilding jobs where the

FIG. 61

cylinders have been refinished or where there is only slight cylinder wall or piston wear. Rebore-Rebuild Sets are less severe than Leak-Proof Sets because they are used in new pistons and where the cylinders approximate their condition when new.

Here again, each piston is different and each make and model of engine is different so each ring in a Rebore-Rebuild set is engineered both as to the make and model of engine and the groove into which it is installed— and here again, substitution should not be made if the best results are to be obtained.

Leak-Proof Sets and Rebore-Rebuild Sets are made up of many different types and kinds of rings. These rings are primarily divided into compression rings and oil rings.

TORSION TIGHT FIRE RING

This is a beveled back, tapered face compression ring (Fig. 62), involving the torsional principle and differing radically from the conventional compression ring.

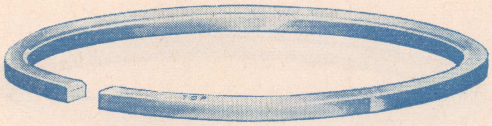


FIG. 62

It has an angular inner structure, mathematically calculated so as to create a powerful torsional force, which actually twists the ring in the groove, causing the lower outside corner of the ring to maintain constant pressure against the cylinder wall, forming an oil seal. This position is held on both the up and down stroke. As a result, the oil is controlled to a point where extremely high oil efficiencies are obtained, with a minimum of blowby.

SEAL CHECK COMPRESSION RING

This is a square groove, expander type compression ring (Fig. 63).

FIG. 63

The outer ring is of the straight faced compression type, with an interrupted groove at the lower outside corner. The expander is made with a reverse loop giving very uniform pressure to the outer ring, thereby causing a tight seal against the cylinder wall.

The compression ring expanders are made from the finest grade of Swedish spring wire.

Two heat treatments are performed on the wire after it is drawn, and then after the wire has been formed into an expander a third heat treatment is given to finally relieve any strains that developed in the forming or shearing operations.

This expander type of ring has the effect of stabilizing the piston and allowing the ring to remain in constant contact with the cylinder wall.

DUPLEX OIL CONTROL RING

The Duplex Oil Control Ring shown in Fig. 64 consists of four separate pieces. The two thin steel rails contacting the cylinder wall are separated by a high unit type cast iron spacer. These three pieces are backed up by a reverse loop expander.

Since the high unit principle is the most effective method of keeping the face of the ring in contact with the cylinder wall, thus allowing the lower scraping edge to shear the excess oil from the cylinder wall, this same principle is retained in the Duplex Oil Control ring spacer, but the high unit pressure faces are modified by continuous reliefs around the outer edges and by enlarging the ventilations to handle a greater amount of oil. The Reverse Loop ring expander is made of the finest grade of Swedish steel, triple heat treated with extra large size drain holes to handle the surplus oil.

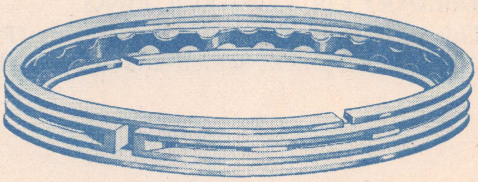


FIG. 64

The two steel rails, one on each side of the high unit spacer, greatly increase the effectiveness of this oil ring by shearing all but a minute film of oil from the cylinder wall.

These rails are very narrow and light in weight. They are independent of each other in their action, and since the full force of the Reverse Loop expander is exerted against these two narrow segments, an extremely high unit load is developed. This high unit load, together with the light weight of these segments, insures continual contact against the cylinder wall, almost regardless of non-uniformity or taper of the cylinder.

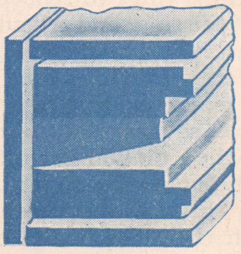


FIG. 65

While the installation of this ring is very simple, the following instructions should be followed (Fig. 65):

1st—Place Expander in Ring Groove with Gap over Pinhole.

2nd—Spiral first Segment in Groove with Gap to Thrust side of Piston.

3rd—Spread cast iron Hi-Unit spacer with a good tool and slip over head of piston into the groove beside the one steel segment.

4th—Spiral second Segment in Groove with Gap opposite Gap of first Segment. USE RING COMPRESSOR FOR INSTALLING IN CYLINDER.

AUXILIARY OIL CONTROL RING

This modern high unit type of oil ring (Fig. 66) is a development which enables the ring

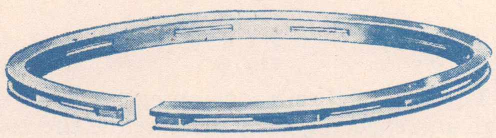


FIG. 66

to remain in better contact with the cylinder wall so that the lower scraping edge will shear the excess oil and distribute it uniformly on the cylinder wall.

By using rings designed for heavy tension, ventilating these rings to relieve the pressure at the face of the ring, and relieving the face of the ring so as to reduce the cylinder wall contacting surface, plus beveling the outside edges of the remaining ring face, the unit load in pounds per square inch is increased to a point where the ring will cut into the oil film rather than ride over the oil film. The surplus oil is drawn through the ventilations in the ring, through the holes in the bottom of the ring groove, back into the crankcase.

CHROME FIRE RING

This anodic chrome faced torsional compression ring (Fig. 67) is the finest heavy duty ring obtainable. Further, its sides are treated to resist wear.

FIG. 67

Operating in the top piston groove of truck, bus and other heavy duty engines, it withstands the high temperatures and minimum lubrication of the combustion chamber while maintaining a permanent seal which prevents blowby from damaging the lower rings. It is built for long life; and by protecting the lower rings on the piston, an installation containing these Chrome Fire Rings gives an exceptionally long life of efficient service.

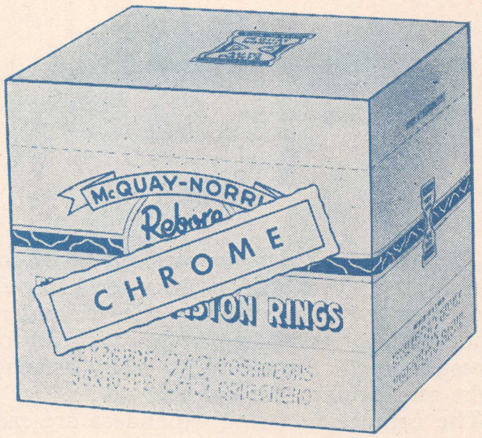


FIG. 68

Many Rebore-Rebuild Ring Sets are engineered with the Chrome Fire Ring. Such sets are identified by the silver "Chrome" seal on the box. (Fig. 68) and are enthusiastically recommended to heavy duty bus and truck fleet operators.

ELECTROLYTIC TIN COATING

How many times has the scuffing or scoring of piston rings, pistons and cylinder walls made it necessary for you to tear down an engine, refinish the cylinders and install new parts?

Figure 69 is a typical example of scuffing where rings with the regular finish or a non-metallic finish were used.

Many finishes have been developed to resist this quick wear, but it was not until Altinizing, and later chrome plating were introduced, that this present day engineering problem was solved.

Figure 70 is a typical example of the absence of scuffing where Altinized rings were installed. The pistons shown in both Figures 69 and 70 were removed from the same motor.

Altinizing primarily is an electrolytic deposition of an alloy of tin on gray iron, and almost regardless of motor conditions, this surface finish will prevent scuffing during the initial running-in of an engine.

USAL FINISH
FIG. 69

ALTINIZED FINISH
FIG. 70

How many times has the slight scuffing of these parts not recognized as such at the time, followed by rapid wear, been responsible for extreme oil consumption after the first few thousand miles of operation?

Scuffing, if only slight, may not be noticed. It is, though, the start of rapid wear which after a very few miles of operation may wear these parts until they are not functioning properly. And with the ever increasing tendency today towards higher speeds and higher compression, with its consequent higher temperatures, the breakdown of lubrication with its metal-to-metal contact causing rapid wear is more likely to occur than ever before.

The prevention of scuffing is not the only advantage obtained by the Altinized finish. Tin, the principal constituent, is an anti-friction metal. Therefore, an engine equipped with Altinized rings operates more freely, that is, with less friction, than an engine equipped with uncoated rings or rings with any other type of coating. The rings are more active in the grooves.

Tin is a soft metal. Altinized rings then seal more quickly, making it unnecessary for a long run-in period before the rings

reach their maximum efficiency

Chart 71 is typical in showing a comparison between the performance of Altinized rings and rings with the regular finish or with a non-metallic finish.

Altinized rings reach their efficiency almost from the very start and maintain a more uniform efficiency throughout their life. Regular finished rings start with a low efficiency, taking several thousand miles of operation to reach their maximum efficiency, after which the efficiency drops off rather quickly.

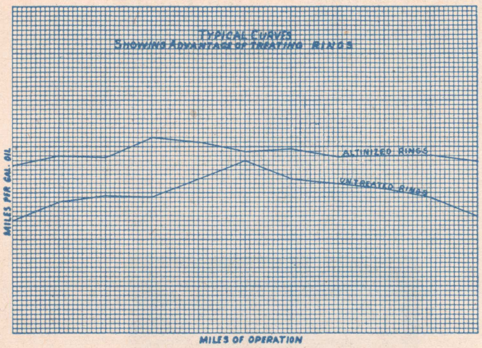


FIG. 71

Tin resists acid corrosion, so consequently Altinized rings resist the effects of the ordinary acids found in an internal combustion engine.

Tin has the ability of retaining an oil film. Altinized rings, then, will have a longer life than uncoated rings or rings having non-metallic coatings, which are generally brittle and poorly bonded to the base betal.

I sincerely believe that Altinizing the surfaces of piston rings is one of the most beneficial developments that has been made in recent years on piston rings.

Altinized rings seal immediately.

Altinized rings reduce scuffing and rapid wear.

Altinized rings resist acid corrosion.

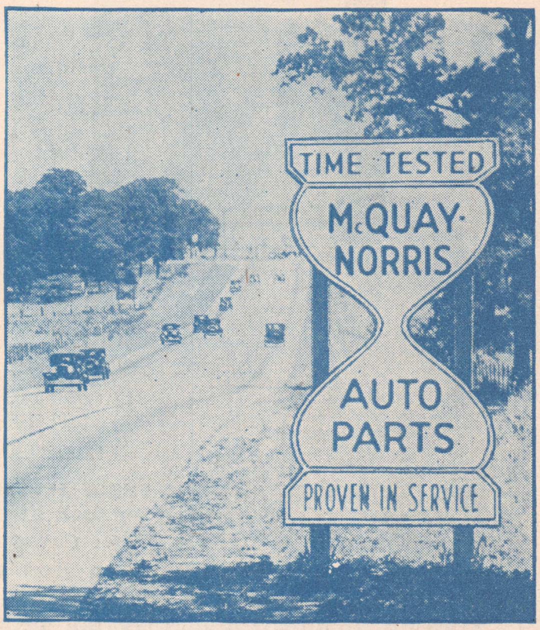
Altinized rings reduce friction, allowing the rings to be more active in the grooves.

I have discussed Reringing, Reconditioning and Rebuilding, explaining the meaning of each term and the necessary operations to perform in each case, together with the necessary parts to install. I have described the latest developments in piston rings and the best combinations of piston rings for each case.

In conclusion, then, I want to emphasize the fact that if the age and condition of the car, the value of the car and the use of the car are taken into consideration, the proper one of the three jobs can be selected—and then, whether the job selected is Complete Rebuilding, Reconditioning or plain Reringing, with the proper type and combination of rings you can guarantee satisfactory performance.

So get the job, whether it is Reringing, Reconditioning or Rebuilding, and then do it right—do it so that you can guarantee complete satisfaction to the car owner.

D. M. SMITH.



RERINGING – RECONDITIONING – REBUILDING

Use Compression-Vacuum Tester for Determining Motor Condition; use Oil Detector for determining condition of bearings; use Centromatic Cylinder Gauge for determining diameter and taper of cylinders—and taking into consideration the value and use of the car, recommend the type of job necessary.

RERINGING

Remove ridge at top and bottom of ring travel.

Clean carbon from ring grooves and oil drain holes.

Cut groove or chamfer below oil ring groove located above pin hole and drill additional drain holes.

Drill additional oil drain holes below pin hole in solid skirt pistons.

Check land clearance and recut lands if necessary.

Expand pistons by resizing or install piston expanders, or both.

Install new connecting rod bearings if necessary.

Align piston and connecting rod assembly.

Fit and install expander rings.

Install valve guides or valve packing.

Recondition valves.

RECONDITIONING

Dress down top of block clean and flat with large mill file.

Refinish cylinders.

Clean cylinders and other parts of the motor of any iron dust, chips or abrasive.

Grind pistons.

Fit pins to new rod bushings.

Assemble piston and connecting rod and align entire assembly.

Fit rings to cylinders.

Install new bearings.

Install piston and connecting rod assembly.

Install new valve guides and grind valve seats.

Install new valves, valve springs and keepers.

REBUILDING

Refinish cylinders, using boring plate.

Clean cylinders and other parts of the motor of any iron dust, chips or abrasive.

Regrind crankshaft.

Replace main bearing inserts or re-babbitt.

Line bore main bearings if required.

Install new valve guides and grind valve seats.

Install cam shaft bearings.

Install new connecting rod bearings.

Install new valves, valve guides, valve springs and keepers.

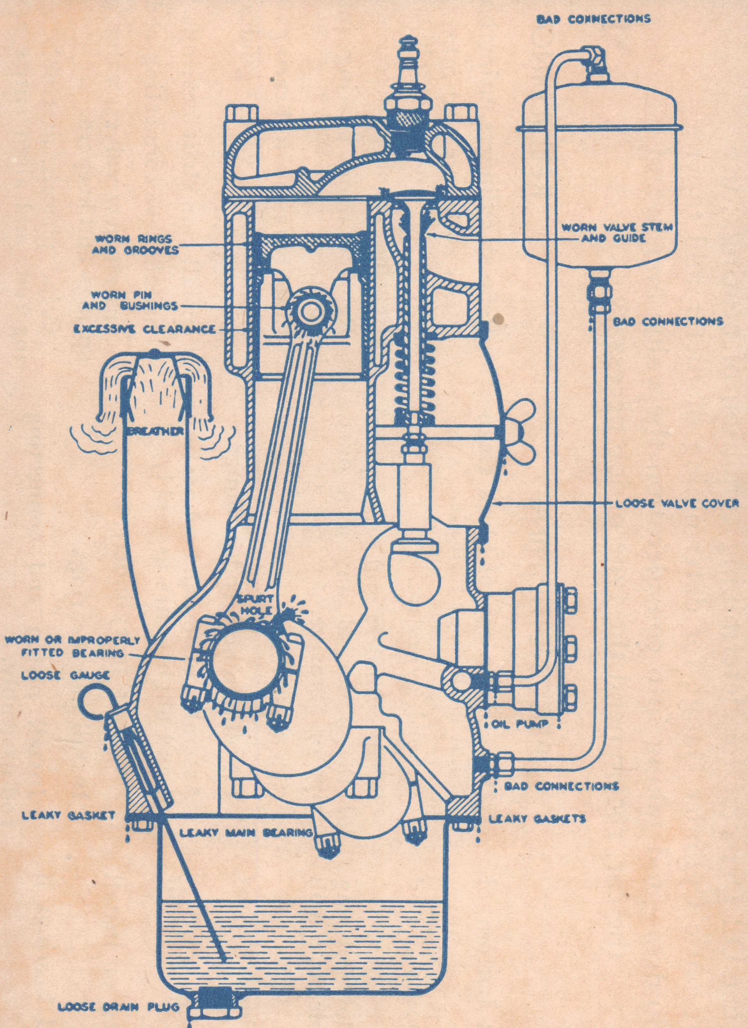
Grind pistons, assemble with connecting rods and align entire assembly.

Fit rings to cylinders.

Install piston and rod assemblies.

Install new timing gears or chain.

Install new gaskets — Clean radiator and water jacket — Clean and service air cleaner — Replace filter or filter element — Check and clean breather outlet or cap — Check and correct carburetion, valve and ignition timing — **Make final check with Compression-Vacuum Tester and Bearing Oil Leak Tester. Run in motor at a speed that will maintain normal oil pressure.**



THE PRINCIPAL SOURCES OF OIL CONSUMPTION